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ERRATA

Page 57, Add to Article 17: "remaining due by the Society."
Page 601, 2nd line from bottom: (*6*) should read (*5*).
Page 602, 4th line from top: (*8*) should read (*6*).
Page 602, 10th line from top: (*9*) should read (*7*).
Page 602, Table 4. Delete (1).
Page 603, Line 1 below Table: (*11*) should read (*9*).
Page 604, Top line should read "Tentative American Method (*9*)."
Page 605, 5th line from bottom should read "much slower determination by weight (*9*)."
Page 606, Delete (*11*) from 2nd and 4th headings.
Page 606, Last line of 2nd and 4th paragraphs, add (*9*).
Page 607, Last line under heading "Protein", add (*10*).
Page 607. Last line under heading "Mellowness" add (*11*).
Page 607, 1st line under heading "Growth": "male" should read "malt."
Page 608, 2nd line from top, add (*11*).
Page 608, Paragraph 2, line 8, "nitrate" should read "filtrate."
Page 609, Bibliography should read as follows:—

1. Wahl and Henius, American hand book of brewing and malting. Vol. 2, p. 847.
2. Kropff, H. Advantages and disadvantages of drying barley. Woch. Brau. 1928, 45 - 336-337.
3. Munerati, O. Is after-ripening necessary? Compt. rend. 1925: 181: 1081.
4. Raux, J. Mould on the germinating floor. Brass. Malt. 1928, 18, 198-202.
5. Reid, R. V. The barley which buyers want. Jour. Institute of Brewing, *32*: 4, 155.
6. Lancaster & Hind. Malting results and analytical results. Jour. Institute of Brewing, *33*: 3, 113 and *34*: 6, 321.
7. Lancaster, H. M. Quality of barley. Brewers Journal, No. 61, p. 617, 1925.
8. Wahl & Henius. American hand book of brewing and malting. Vol. 2, pages 847-852.
9. ———————— American hand book of brewing and malting.. Vol. 2, pages 853-862.
10. Official methods of agricultural chemists.
11. Wahl and Henius. American hand book of brewing and malting. Vol. 1, pages 548-551.

Page 611, First line of article should read: "In a previous communication (*1*) this question has been," etc.
Page 628, Paragraph 2, line 4, "expense" should read "response".
Page 746, Delete line at end of "Literature cited".

SCIENTIFIC AGRICULTURE

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INFLUENCES WHICH TEND TO AFFECT SEED PRODUCTION IN ALFALFA AND AN ATTEMPT TO RAISE A HIGH SEED-PRODUCING STRAIN BY HYBRIDIZATION.

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[Received for publication May 28, 1928.]

SECTION I.

It is now generally well recognized by experienced growers of alfalfa seed that the crop produced in different seasons is exceedingly variable both in quantity and quality. In certain areas where both soil and climatic conditions are apparently unfavorable for seed setting no known cultural treatment and no special strain of alfalfa seem to be effective in causing even a moderate crop of seed to set. Even in those regions where conditions for seed production seem to be most favorable there are frequently seasons when only a small percentage of the flowers set seed, thus resulting in a disappointing crop to the grower.

With the hope of finding a satisfactory explanation as to why alfalfa should be such an erratic seed producer, various specially designed experiments, together with numerous general field observations, have been conducted by various workers in recent years.

GENERAL OBSERVATIONS AND CULTURAL TREATMENTS

It is quite obvious that the seed grower will be specially interested in the various agencies which affect alfalfa seed production, and in order to find some practical method of inducing seed to set various cultural methods have been tested.

One common method of sowing is to sow the seed broadcast from every spout of the seed drill. The advocates of this system maintain that when the land is completely covered by plants there is naturally more competition, and consequently more moisture is lost by transpiration through the leaves of the crop. There is also a greater demand upon the supplies of plant food and the general result of such competition (it is claimed) is a less tendency of the alfalfa to produce an excessive growth of leaf and stem and a greater inducement for plants to run to seed.

On the other hand, some seed growers hold that by growing alfalfa in three-foot rows the crop receives more air and sunlight. This helps to produce a healthier and more vigorous growth of flowers with an increased tendency to become fertilized and produce more seed than when the plants are more or less crowded together in a broadcast plot.

*Since the manuscript of the above article was submitted for publication, the author's address has been changed to: Bushley, Roden Avenue, Kidderminster, England.—Editor.

Further it is sometimes recommended that applications of lime and phosphatic fertilizers may be used with good effect to hasten the maturing of the crop and thus encourage earlier and more complete setting of seed.

While it may so happen that one or other of the above systems of treatment may have proved to be effective in promoting seed formation under a given set of conditions in a particular season, yet it will frequently be found that the same treatment on the same field in a different season fails to bring about satisfactory results.

Hence in surveying this problem in the light of the uncertainty of any known methods of overcoming erratic setting of seed, one can appreciate the position of the experienced grower when he says he never feels certain of what the yield will be until he sees the seed in the sack.

Influence of Soil and Situation

Under the same weather conditions and in the same season it has been noticed that soils vary very markedly in their effects on the setting of alfalfa seed. When grown in humid districts on soils inclined to be somewhat open and porous and containing an abundance of lime, alfalfa seems to have a greater tendency to set seed than on heavy damp soils in the same district. On these heavy damp soils, when the plant does begin to set seed it still continues to produce new shoots and leaves in abundance; this being the case, much of the plant food which should be utilized in the development of seed is expended in the production of stem and leaf, with the result that many of the seeds which have set never become developed to maturity but are simply *thin, brown, undeveloped*, dead seeds.

Heavy soils under such conditions may be excellent for producing hay and fodder but should not be expected to yield a crop of seed. Where the topography of the land is rolling, good crops of seed are often produced on heavy clay soils; the seed usually sets well on the knolls while in the intervening hollows the alfalfa after a few years usually dies out.

Some loamy soils, in which the sandy particles are in a very fine state of division, do not give up their water supply to the plant very readily; this promotes a somewhat slow steady growth without excessive production of leaf and stem. These conditions seem to favor the setting of seed and the food supply of the plant is utilized largely in the feeding and development of seed rather than in increasing vegetative growth.

Influence of Weather Conditions

Experienced growers of alfalfa seed are well acquainted with the general effect that weather conditions may have on the seed crop. In regions where the climate is inclined to be humid, the best crops are usually obtained in the driest seasons. It is also found that in the more arid sections of the United States extreme dryness is unfavorable for a good yield of seed.

The extent to which weather conditions may influence alfalfa seed production (particularly in Utah) has been made a special study by J. Cecil Alter, Meteorologist, United States Weather Bureau (*1*). The average seed crops, together with records extending over nine seasons, were used by this investigator. From these data valuable conclusions were drawn, which may be briefly summarized as follows:

1. The alfalfa plant when considered for seed is very exacting in its meteorological requirements.

2. Climate is the limiting factor in seed production generally, and current weather is the major control affecting any yield. A certain amount of strain on the plant, due to drought, is necessary to force the setting of seed.

3. Humid climates may be considered unfavorable.

4. The summer must be quite dry to encourage the crop to produce seed rather than stem and leaf growth, and yet moisture must be ample and timely for filling the seed.

5. When moisture is deficient and dry hot winds are prevalent, particularly at blossoming time, many of the flowers wilt and fall off instead of becoming fertilized and setting seed.

6. In areas where irrigation is practised too much irrigation water, or too little, may prevent a good yield of seed.

Influence of Moisture Determined

The conclusions drawn from the effects of climatic conditions on seed production strongly emphasize the necessity of an adequate and yet not an excessive amount of moisture.

The specific influence of moisture (soil moisture and atmospheric moisture) on the fertilization of alfalfa flowers has been well demonstrated by means of carefully controlled laboratory and field experiments by J. N. Martin, Botany Department, Iowa State College (*8*). This investigator in the course of his researches brings out some exceedingly interesting and valuable information on this problem.

In the first place it was found that, by the use of specially designed laboratory equipment, it was possible to demonstrate that an excess of moisture, either in the soil or atmosphere, apparently did not interfere with the healthy development of the ovule and from this it was assumed that the failure of the ovule to become fertilized was due to non-functioning of the pollen.

Attention was then directed towards ascertaining the various conditions which control the germination of pollen and a method of investigation was followed as outlined below:

a. Artificial stigmas were prepared with and without sugar solutions and germination of pollen under definite percentages of atmospheric moisture.

b. The work was then carried on to a study of the germination of pollen on the stigmas of tripped flowers under similar conditions of atmospheric moisture as used with artificial stigmas.

c. Selected plants in pots were taken and transferred to a specially constructed glass box in which the atmospheric moisture could be determined and the number of seed pods formed readily counted.

d. Plants in a plot of alfalfa were tested under field conditions. Estimations of the percentage of soil moisture were made before and after the experiment; also daily determinations of atmospheric moisture at different times in the day. Alfalfa was also given an excessive amount of water and the effect on seed setting ascertained.

These four sets of experiments seem to support the same view, viz:—that unless the pollen's imbibition of water from the stigma and its evapora-

tion into the air are properly balanced no fertilization of the ovary will take place.

The summarized conclusions drawn from the above experiments seem to be of sufficient importance to be quoted in detail:

"1. The setting of seed pods in alfalfa is dependent upon the proper functioning of the pollen.

"2. Germination of the pollen depends upon a proper supply of moisture. If the water supply is either above or below a certain requirement the pollen does not germinate.

"3. The water requirement for germination of the pollen depends upon a certain ratio between the moisture delivered by the stigma and the moisture of the air surrounding the stigma.

"4. It follows, therefore, that when the optimum supply of soil and atmospheric moisture for pollen germination is available, an increase in soil moisture, resulting in an increased moisture delivery of the stigma, or a change in the atmospheric moisture, disturbs the required moisture supply for pollen germination and prevents fertilization.

"5: The blasting of seed is due to the arrested development of the embryo.

"6. This arrestment may be due to the plant's inability to furnish the proper water and food supply for the maturing of seed during drought, or it may be due to the pathological condition to which the seed is more susceptible under drought conditions."

When the results of the two investigations quoted above are compared it will be readily seen that the botanist, by direct appeal through the plant, arrived by a quite different route at practically similar conclusions to those of the meteorologist, namely, that failure to secure a properly balanced supply of soil and atmospheric moisture is the real cause of alfalfa flowers refusing to set seed.

Pollination and Fertilization of Alfalfa Flowers

With the object of throwing light on the pollination and fertilization of alfalfa flowers many general observations, together with well designed investigations, have been made by various workers over a long period of time.

Some of the earlier investigators made a more or less careful examination of the structure and mechanism of the flower and a summary of the findings of these early experiments from 1832 onwards is given in a bulletin by the late C. V. Piper and co-workers of the U. S. Dept. of Agriculture (*9*). In this bulletin it is pointed out that the information obtained by the pioneer workers with regard to structure, mechanism, pollination and fertilization of alfalfa, was of such a conflicting nature that further research is necessary so that more light may be obtained on a subject which is somewhat obscure and not easy to elucidate. In the same publication the results of experiments conducted over a series of years are presented. Some of the outstanding facts and conclusions brought out by these experiments when summarized show:

"1. At seven different stations in various parts of the United States it was found when alfalfa flowers were artificially self-fertilized (tripped)

30.68 per cent proved to be fertile, while on the same plants exposed only to natural conditions 16.76 per cent of the flowers proved to be fertile.

"2. At one centre (Chinook, Montana) a number of selected plants were tested and it was found that of 121 flowers tested in 1909, 57 per cent were found to trip naturally and 53.6 per cent of these naturally tripped flowers were fertile.

"In a similar experiment conducted at Pullman, Wash., in 1910, of 775 flowers on nine different plants only 7.7 per cent of the flowers tripped automatically and 35 per cent of the tripped flowers were fertile.

"3. The principal natural agents of cross-pollination in alfalfa are various species of wild bees. Honey bees trip only a very small percentage of flowers; butterflies and night flying insects are negligible; rain and wind cause but few flowers to become tripped.

"4. There is a wide range of variability in alfalfa plants as regards the readiness with which the flowers become tripped either automatically or by the aid of external objects and also in their ability to set fruit when tripped."

Judging from the above results it is quite apparent that the percentage of alfalfa flowers which trip naturally varies very greatly in different districts; this serves again to emphasize the effect that particular soil and climatic conditions may have on the setting of alfalfa seed.

Experiments and observations conducted at the Manitoba Agricultural College on the natural agents of cross-pollination in alfalfa tend to confirm the conclusions quoted above: that honey bees, butterflies, moths, wind and rain have little if any effect on the tripping of alfalfa flowers; also that alfalfa plants vary greatly amongst themselves in the readiness with which flowers trip and their ability to set seed even when tripped.

Table 1 gives a summary of pollination tests conducted over a period of four years at this college. Number of plants used in test, 25.

TABLE 1.—*Summary of tripping tests of individual alfalfa plants from various strains.*

Various Treatments	1920	1921	1924	1925	Totals
Number of plants tested	6	3	10	6	25
Number of flowers tested	3583	957	4253	4394	15187
Flowers caged and not tripped by hand	1202	268	1051	1369	3890
Percent of above flowers forming pods	11%	27.1%	3.7%	9.64%	12.8%
Flowers caged and tripped by hand	1191	176	1060	997	3424
Percent of above flowers forming pods	60%	50%	30%	45.93%	46.5%
Flowers exposed and not tripped by hand	458	327	1087	1229	3101
Percent of above flowers forming pods	40%	38.2%	8.1%	19.44%	26.4%
Flowers exposed and hand tripped	732	186	1055	799	2772
Percent of above flowers forming pods	54.5%	48.3%	34.8%	49.93%	46.8%

On examining the four year results summarized in the foregoing table it will be seen:

1. *Caged flowers.* When alfalfa flowers were protected from the visits of insects a very small percentage, 12.8, formed seed pods, yet when the flowers on the same plant were similarly protected and tripped by hand nearly four times as many, 46.5 per cent, seed pods were produced, which in this case means that nearly one half of the tripped flowers were fertile.
2. *Exposed flowers.* When flowers were exposed to natural conditions and not tripped, slightly over one quarter of the flowers developed pods, viz, 26.4 per cent.

   Hand tripping the exposed flowers increased the percentage of fertile flowers to 46.8, or practically the same total as obtained in the caged flowers when hand-tripped.

   Thus these tests show that, under the conditions obtaining at this station, the operation of hand-tripping exposed alfalfa flowers resulted in a marked increase in fertility and indicates that if we wish to produce a heavy yield of alfalfa seed it is necessary that the flowers be tripped either by artificial or natural agencies.

Seasonal Variability in Seed Setting of Alfalfa

As already noted above there is a wide range of variability in alfalfa plants as regards their tendency to become tripped and set seed; furthermore, there is likewise a very wide range of variation in the ability of the same plant to set seed over several seasons in succession.

To illustrate this point an example is given in Table 2, showing the variation in seed production of a single plant (F_3 No. 40) over a period of seven seasons. This plant was the mother plant of the strain of alfalfa now known as Macsel.

Table 2.

Crop year		Weight of seed (ounces)
Seed sown	1916	
	1917	6.1
	1918	1.0
	1919	2.0
	1920	4.5
	1921	1.3
	1922	2.2
	1923	0.6

From these results it is apparent that the seeding capacity of a plant may fluctuate greatly from year to year and that the inherent tendency of a good seeding plant to produce seed may somehow be so influenced, either by weather conditions or some internal physiological change in the plant, that the abundant production of seed is greatly restricted.

Seeking a Remedy by Selection Methods

Judging from the conclusions based upon experiments well designed and carefully carried out, together with general weather and field observations, the conditions which govern the ability of alfalfa to set seed seem to have been (at least to some extent) fairly well diagnosed.

The important question which naturally follows is — How to find a remedy?

Since weather and soil conditions play so important a part in seed production, it is sometimes suggested that those areas where climate and soil are best adapted for the purpose should grow seed for use in those sections well suited for the production of forage but less well adapted for the growing of seed. This practice is probably in part carried out but, on the other hand, it is frequently found that with alfalfa, as with many other farm crops, acclimatized strains generally give much better returns in their own district than those strains which are introduced from a distance; hence we have the well founded preference amongst farmers for home grown seed.

Having in mind the various benefits to be derived by the farmer from using home grown seed, many of our field experiment stations in Canada have included alfalfa in their projects for the improvement of farm crops.

Much selection work has been done and various strains isolated, some of which are giving good promise. While some of these selected strains have acquired something of a local reputation, they have not yet had time to become widely known commercially.

In a recent issue of *Scientific Agriculture* (*6*), L. E. Kirk of the University of Saskatchewan gives an interesting and instructive account of his experiments in obtaining (by selection) improved strains of alfalfa for seed production. These experiments extended over a series of years, several thousands of individual plants being raised and studied. After these exhaustive and extensive investigations the author draws the following conclusions respecting alfalfa seed production:

"1. Alfalfa was artificially self-pollinated for three generations and first, second and third generation selfed lines were grown under comparable conditions for comparison with each other and with the open pollinated parental material. On the average, a pronounced and progressive reduction in vigor of growth was observed for each generation of selfing. A few of the second and third generation selfed lines were not significantly different in yield from the corresponding open-pollinated strains from which they were obtained.

"2. The mean yield of seed for second generation selfed lines of alfalfa showed a marked decrease as compared with the seed yield of the corresponding open-pollinated strains.

"A few second generation selfed lines compared favorably with the original material in the amount of seed produced.

"3. A significant correlation coefficient of $r = 0.46 \pm 0.08$ was obtained for the relationship of seed setting between first and second generation selfed lines of alfalfa. This would seem to indicate that the characters of high and low seed production are inherited to a considerable extent."

Reasoning from the results given above the author concludes. It would appear, therefore, that it may not be a difficult matter to secure selfed lines of alfalfa which are vigorous and also some which will yield at least a normal crop of seed.

The conclusions to which the author of the above report has arrived are quite encouraging and lead one to hope that eventually a strain of

alfalfa may be developed which will possess the necessary hardiness and forage-yielding capacity and will also have seeding properties sufficiently well stabilized to guarantee a good set of seed in an average season.

Judging from field investigations carried on at this college during the past eleven years it would appear that, given a sufficient length of time to cover various types of seasons, it is not a very difficult matter to isolate strains of alfalfa which are good forage producers and quite able to withstand our severest prairie winters, but to develop a strain having these desirable forage properties, combined with a consistently good yield of seed from year to year, is a much more difficult task.

In the course of our selection work, at least three strains have been isolated which we believe to have a general superiority over the well known commercial varieties of alfalfa. These improved strains are now under test side by side with strains selected by other plant breeders, together with strains from commercial sources. These trials have not yet been under way for a sufficient length of time to warrant drawing any definite conclusions; we may, however, state that in general, our opinions as to the improvement which may be effected in alfalfa by isolation, selection, and self-fertilization do not differ very materially from those reported by other workers. If there is a difference it probably lies in the direction that the writer is perhaps not quite so optimistic of obtaining an outstanding measure of success in stabilizing alfalfa seed production by straight selection alone, and is of opinion that a well designed system of hybridization, together with selection, may in the long run take us nearer to the goal we are seeking.

Is Hybridization of Alfalfa Necessary?

The writer's first acquaintance with the study of alfalfa for the purpose of improving the plant began in 1911 at the Ontario Agricultural College where selection work was then in progress. It seemed at that time to be a well established fact that one of the outstanding deficiencies of alfalfa was its poor seed-producing propensities, and selection work was being directed mainly towards the isolation of hardy plants having a greater capacity to produce seed. By a careful study of individual plants in over seventy different strains the opinion was formed that not a single plant in all the strains possessed seed forming habits which could be considered sufficiently satisfactory to form the basis of a heavy seed producing strain. Later it was also found that if a particular plant should prove to be a fairly good seeder the chances seemed to be against any of the progeny being equal to the parent.

These early experiences led one to infer that alfalfa being naturally a shy seeder, its improvement by selection was limited to eliminating poor seeders and isolating the most desirable seed producing plants, and so could not be expected to produce anything higher or better in seed producing capacity than was originally present in the crop. The above inference seemed to be justified and the conclusion was drawn that, though some improvement might be brought about by straight selection, this method alone apparently did not offer a satisfactory means of obtaining a first class seed producing strain.

Experiments conducted over a period of two years showed that alfalfa flowers protected from the visits of insects (and not tripped by hand) failed to set a single seed, yet when flowers on the same plants were hand tripped seed set freely. These results seemed to indicate that in order to obtain a plant having first class seeding properties, attention should be directed towards finding a plant with self-tripping flowers. Search amongst seventy strains failed to discover a single plant having the characteristic desired and it was apparent that in order to find such a plant it would be necessary to leave alfalfa and look for the self-tripping habit in some other species of plant.

One of the weeds growing in the college experimental grounds at that time was the well known Black Medick (*Medicago lupulina*). This plant, though of the same genus as alfalfa, was always heavily laden with seed, and preliminary tests proved that when insects were excluded the flowers continued to produce an abundant supply of seed; this free seeding tendency was apparently due to the self-tripping habit possessed by Black Medick and the problem was naturally suggested: Why not try to cross alfalfa with Black Medick and risk the possibility of producing a fertile hybrid and ultimately combining the good forage properties of alfalfa with the abundant seed producing habits of Black Medick?

Having decided to make the attempt work was commenced with all the enthusiasm of a novice. After much practice in emasculating and pollinating, a certain amount of dexterity was acquired in manipulating the reproductive organs of alfalfa flowers. It was found, however, that when the small insignificant flowers of the Black Medick had to be taken in hand the task was very much more difficult; moreover, it was found that the Black Medick produced only a very meagre supply of pollen and it was difficult at times to obtain sufficient for purposes of pollination.

After working throughout the unusually hot summer of 1911 without any apparent results, enthusiasm began to wane and as the alfalfa plants began to shrivel and dry up healthy alfalfa flowers were becoming more and more scarce; finally, in order to find a healthy plant with suitable flowers one had to go to a plot of alfalfa of unknown origin which had been previously ploughed up but had a few living plants left which were growing vigorously. On one of these plants a number of flowers were pollinated by Black Medick and seven pods developed.

When these pods were first observed they were the cause of considerable satisfaction and excitement in the worker. Like many another inexperienced hybridist in a similar state it was now thought that the great task of combining the desirable properties of alfalfa and Black Medick had been well nigh acomplished and all that was needed henceforth was to grow seed and select out plants having the required characteristics. After having followed the progeny of these hybrids in their elusive sportings during the past 15 years there now appears to be good reason to believe that a combination of some of the good properties of the two parents have combined in one plant.

SECTION II.

Summary of Hybridization of Alfalfa and Black Medick*

In the following summary a brief statement is given regarding the early stages of these investigations, together with an outline of successive stages in the selection work carried on in one particular hybrid line (2^a) from 1916 to 1927.

1911-12—Alfalfa flowers caged and not tripped for two seasons failed to produce a single seed. Flowers similarly caged, but tripped, set seed freely. Black Medick caged but not tripped produced an abundance of seed. Decided to try and cross alfalfa with Black Medick.

Fertile hybrid obtained between alfalfa and Black Medick and was given the number 2.

1912 Twenty-four plants raised in greenhouse. When planted out in field nearly all plants suffered from chlorosis during the first year. Some plants were stunted in habit, others quite normal.

1913 Plants regained green color; stunted habit less pronounced. Some flowers in most plants with abnormally formed flowers; very few seeds produced.

1914 Raised crop of second generation plants.

1915 Seed gathered from selected F_2 plants. (Ontario Agricultural College).

1916 Individual plants of F_3 raised; several promising plants appeared. (Manitoba Agricultural College).

1917 In F_3 crop a special plant (No. 40) selected, yielded 6.1 ounces of seed. Two stunted plants with malformed flowers appeared; both died off in second year.

1918 Raised plants with selfed seed from plant 40. (Surplus seed was increased and used to develop the strain of alfalfa now known as Macsel). (See Table 2).

1919 One plant F_4 (No. 15), progeny of No. 40, proved to have the self-tripping habit of Black Medick strongly developed but was completely sterile.

1920 Plants developed from sterile plant F_4 (No. 15) by means of cuttings.

1921-22 Plants raised by cuttings from sterile plant F_4 (No. 15) began to produce a few seeds. The original mother plant F_4 (No. 15) also produced a few seeds.

1923 Seed from plants raised by cuttings used to raise F_5 generation. In this crop one plant (No. 11) was found which had some flowers with the keel petals opening (at tip) automatically, thus exposing stamens and pistils. Several hundred seeds produced.

1924 Seed from F_5 (No. 11) used to produce F_6 generation.

1925 Out of 119 plants raised, 16 per cent produced flowers having the self-tripping habit more or less strongly developed. With one exception, F_6 (No. 5), these self-tripping plants showed a high degree

*In carrying out many of the details of these investigations at various times from 1917 onwards the writer wishes to express grateful appreciation of the valuable assistance received from the following: A. T. Elders, B.S.A., M.S.; S. E. Clarke, B.S.A., Ph.D.; H. E. West, B.S.A.; E. W. Atkins, B.S.A.

of sterility usually associated with floral abnormality. One plant produced flowers 100 per cent self-tripping and 100 per cent sterile.

1926 Counts made of caged flowers on fertile plant F_6 (No. 5) showed 88 per cent of flowers self-tripped and 59 per cent of these produced seed pods.

Raised over 200 plants F_7.

1927 In F_7 generation 15 per cent of plants showed good seeding properties; while several were self-tripping and fertile a few were completely sterile. Another crop of F_7 plants raised from F_6 (No. 5).

A detailed account of the appearance of first generation plants, with a discussion of the characteristics of a crop of F_2 plants grown under greenhouse conditions, will be found in a previous article (*10*).

The system adopted in numbering and recording the hybrid plants is given in Table 3 and may here be described as follows:

1. The first cross between Alfalfa ♀ and ♂ Black Medick was recorded as No. 2.
2. Each pod produced from No. 2 cross was given a distinguishing letter and so the five pods obtained were known respectively as pods a, b, c, d, e.
3. The seeds in each pod were given consecutive numbers; for example, pod (a) contained seven seeds which were numbered from 1 to 7 inclusive.
4. When the seeds germinated the plant produced took on the number given to the seed so that if each of the seeds in pod (a) gave rise to a plant they would be designated by 2^{a-1}, 2^{a-2}, etc., and so on to 2^{a-7}, according to the number of plants raised. If a seed failed to germinate of course that number would automatically drop out.
5. In F_2 and subsequent generations the same system was continued. For example, suppose a crop of fifty plants is raised from seed from plant 2^{a-7} and from this crop plant 18 is selected to carry on the test, this selection would be recorded thus:—2^{a-7-18}. If it is found necessary to carry the generations beyond F_6 or F_7 the length of the pedigree becomes unwieldy and it will then be found convenient to adopt a new number and begin a fresh record.

An examination of Table 3 will show that the plants produced from seeds from the same pod varied very considerably in size as well as in peculiarities of leaf and stem. There was a striking variation also in the colour of the flowers and in the structure of the floral organs. All the plants produced variegated flowers and the tints varied on almost every plant. The chief colours were violet shading into purple, dark purple and green. In some flowers the edges of the keel were lined with yellow but this colour was never found on the wings or standard.

A few plants produced abnormal flowers. In structure these abnormal flowers had an enlarged keel which appeared to be swollen but only contained the normal number of stamens and one pistil. The pistil, however, did not remain enclosed in the keel as in a normal alfalfa flower but pushed its way out and the stigma could be clearly seen standing out from the keel.

TABLE 3.—*Showing the pods and seeds from each pod from first hybrid cross No. 2 of Alfalfa ♀ × ♂ Black Medick made in 1911. Also a brief description of the principal vegetative characteristics of F_1 plants.*

No. of cross	No. of pod	No. of seed	No. of plant	Average height of plant inches	Character of stem	Remarks on leaves
2	a	1	*			
	"	2	*			
	"	3	–3	14	Thin slender	Many
	"	4	–4	11	Almost rigid	Medium number
	"	5	–5	15.50	Thin slender	Not numerous
	"	6	–6	7.50	Rigid	Very many
	"	7	–7	20.50†	Very thin slender	Very small, few
2	b	1	*			
	"	2	–2	12.50	Almost rigid	Numerous
	"	3	–3	15.00	Medium	Many densely crowded
	"	4	*			
	"	5	–5	12.50	Medium	Not numerous
	"	6	–6	14.75	Medium	Many densely crowded
2	c	1	*			
	"	2	–2	23.00	Thin slender	Few sparsely scattered
	"	3	–3	6.50	Rigid	Many densely crowded
	"	4	–4	18.50	Stout not rigid	Medium number
2	d	1	*			
	"	2	–2	14.75	Not rigid	Medium number
	"	3	–3	10.50	Almost rigid	Not numerous
	"	4	–4	9.50	Rigid	Many densely crowded
2	e	1	*			
	"	2	–2	7.00	Rigid	Many densely crowded
	"	3	–3	8.50	Almost rigid	Many

†The plant No. 2 – 7) is the foundation plant of the hybrids with which we are specially concerned in the present article the progeny having been studied through seven generations. Photographs showing a portion of each of these F_1 plants are given in plate II.

*No plant produced.

This habit of the pistil, with the surrounding stamens pushing voluntarily out of the keel, is a characteristic of the self-tripping Black Medick. Unfortunately most of these malformed flowers proved to be sterile. With the exception of a few abnormal plants this tendency of the flowers of these hybrid plants to trip naturally seemed to be almost entirely suppressed during F_2 and F_3 generations but reappeared again in F_4 as will be explained later.

Another peculiarity of these first generation plants was that nearly all of them suffered from a deficiency of chlorophyll and this characteristic did not develop until the plants were four to five inches tall and well established in the field. Most of these chlorotic plants gradually developed into a normal green colour but a few seemed always to have some pale yellowish green leaves at the tip of the shoot.

In the second generation chlorophyll deficiency was not so common; out of 229 plants 48, or 26.5 per cent, were distinctly chlorotic. In F_3 only a few plants were seen, while in F_4 and later generations only an occasional plant was found suffering from chlorosis. It was noticed that this chlorotic

condition of the leaves seemed in some cases to be associated with abnormality in the flowers, also that those plants most severely attacked had less resistance to winter killing and usually died off after the second or third winter.

With the exception of the above noted variations the F_2 plants had a general resemblance to ordinary alfalfa, and while some plants had a prostrate habit of growth none was found which could be considered as having any very close structural resemblance to the male parent Black Medick.

Third Generation Plants

Though the plants of the first and second generation had shown striking variations both in general structure and flower colour, no plants had yet been found which gave much promise as seed producers.

In 1916, from the seed of seven selected F_2 plants, a new crop of 410 plants was raised. These seven lots of F_3 plants still showed great variability but there seemed to be a tendency in some of the selections to have more or less similarity in a number of the individual members.

In one selection a large proportion of the plants had the thin prostrate stems and an abundance of small leaves characteristic of Black Medick. In this group 30 per cent of the plants produced creeping underground stems; these were all exceedingly low in seed yield and at least one plant was completely sterile. This plant was easily reproduced vegetatively and the crop thus raised has proved to be the hardiest strain and gives the best quality of forage of any strain we have yet tested. An attempt is being made to overcome this sterility and retain the good forage qualities and hardiness by crossing with a heavy seed producer. A fertile cross having been obtained and over 700 F_2 plants raised it can now be seen that the good forage properties have been readily transmitted but no high seed producing plants have yet been found.

In another of these F_3 groups one plant was found which produced very few flowers but they were distinctly abnormal and self-tripping. The main stems and branches had shortened internodes, which gave the plant a peculiar stunted appearance somewhat resembling the F_1 plant shown in Figure 5, Plate II. The flowers of this plant were completely sterile and as attempts to reproduce by means of cuttings were not successful the plant was lost.

Another group from one of these seven F_2 selections proved to have a fair number of plants giving more than an average amount of seed. In 1917, the first year after planting, out of 56 plants twelve were selected and tested for seed production; the average yield per plant was 2.7 ounces. The lowest yield was half an ounce and the highest 6.2 ounces. This was gathered from plant F_3 No. 40 (Text Fig. 1). A few racemes of flowers were enclosed in a muslin cage and selfed seed obtained in order to test the tendency of this plant to transmit its good seed producing characteristics. A record of the seed produced by this plant during seven seasons is given in Table 2.

Fourth Generation Progeny of Plant F_3 No. 40.

None of the plants raised from (F_3 40) seemed to have fully inherited the free seeding habits of the parent; a few were fairly good, some decidedly

TEXT FIGURE 1. Hybrid Plant (F_3 40) in full flower. Mother plant of Macsel alfalfa.

poor and one plant (F_4 15) was absolutely sterile for two seasons. In general appearance and structure this plant (except the flowers) closely resembled alfalfa (Text Fig. 2). The flowers were carried in exceptionally long racemes and were seen to be quite abnormal. As the flowers became mature, instead of the sexual organs remaining enclosed in the keel until liberated mechanically as in alfalfa, the keel petals opened automatically thus exposing both stamens and stigma (see Text Fig. 3). In these flowers the staminal column seemed to have lost its spring-like force and if an attempt was

TEXT FIGURE 2. Hybrid Plant (F_4 15) in full flower. Totally sterile for two years.

made to trip a newly opened flower by hand the sexual column tripped very weakly or not at all. On making a close examination of the sexual organs it was found that in most flowers the top portion of the style was bent back upon itself after the manner of the style in Black Medick, only more bent and in some cases the face of the stigma was directed towards the base of the flower.

Many attempts were made to encourage this plant (F_4 15) to produce seed by selfing and by using pollen from the parent as well as from unrelated

TEXT FIGURE 3. Racemes A.B. from (F_4 15) with sterile self-tripping flowers seen especially near base of raceme: C. Raceme of normal flowers.

plants but without success. The plant refused to set seed until the third season when a few seeds were obtained by natural open fertilization. When it was first found that the plant proved to be self-tripping and quite sterile, and so as not to lose the strain, thirty plants were raised from cuttings. These plants also produced a few seeds and it is from the progeny raised from these seeds that the work in this particular line has been continued.

FIFTH GENERATION:—PROGENY OF SEED PRODUCED BY CUTTINGS FROM PLANT (F_4 No. 15).

From this seed thirty-five plants were raised and after a careful examination of the flowers of each plant it was found that, with the exception of one plant (F_5 No. 11), the flowers throughout this group were apparently similar to those of normal alfalfa (Text Fig. 4). In some of the flowers of No. 11, though they appeared to be structurally quite normal and not truly self-tripping as is seen in the flowers of Black Medick, the anthers along with the stigma had a tendency to push their way out at the tip of the keel while the rest of the keel remained closed. Judging from the way the majority of these flowers behaved it would seem that the self-tripping habit of the F_4

TEXT FIGURE 4. Hybrid Plant (F_5 11) self-tripping largely sppressed.

parent was almost completely suppressed in F_5. Though this plant (F_5 No. 11) could not be classed as a good seeder it was far from being sterile and selfed seed was obtained for further trial.

SIXTH GENERATION RAISED FROM SEED FROM F_5 No. 11.

In this crop of the sixth generation the self-tripping habit again made its appearance in a very decided fashion. Out of the 122 plants raised in 1924 it was found in the following year that there were five plants in which at least 90 per cent of the flowers were self-tripped. Unfortunately, with the exception of one or two plants which produced very few seeds, the flowers of these self-tripping plants were completely sterile; they were also very tender plants and almost killed out during the second winter after planting. Ten other plants were found producing self-tripping flowers varying from 5 per cent to 55 per cent; most of these plants produced a few seeds.

One specimen in this generation (F_6 No. 5) stands out as being distinctly superior to any of the rest. It is a tall vigorous plant, very robust after four winters, is a good forage type and an excellent seeder (Text Fig. 5).

TEXT FIGURE 5. Hybrid plant (F_6 No. 5) over 4 ft. high, 88 per cent of flowers self-tripping, 59 per cent fertile.

In the summer of 1926 a scheme was designed to test the extent to which the flowers on this plant were self-tripping and fertile and to compare the results with Grimm alfalfa when given the same treatment. The results are shown in Table 4.

Treatment: On each plant two sets of racemes were selected, with 20 racemes in each set. Each set was inclosed in a fine muslin cage to prevent insects visiting the flowers.

Before enclosing the racemes, all the opened flowers were carefully removed and the remaining flower buds counted. As the flower buds came into bloom a record was kept of the self-tripped and non-tripped flowers. These flowers were marked; then when pods were formed on fertile flowers they were counted and results recorded as given in table.

Seventh Generation Raised From Seed From F_6 No. 5.

In 1926 a plot of 213 plants was raised but as we have had only the one clear season of 1927 for a study of these F_7 plants a detailed analysis of the crop will not now be attempted. It may, however, be mentioned that of the 213 plants at least 24 seemed to have a varying percentage of auto-

self-tripping fertile hybrid plant (F_6 No. 5) compared with two plants of Grimm alfalfa.

	No. of Plants tested 1926	No. of Racemes	Flower buds counted		Flower buds caged : Self-tripped				Date 1926	
			No. caged	Pods formed per cent	Total Self-tripped	Per cent Self-tripped	Pods formed	Per cent pods formed	Buds enclosed	Flowers counted various dates
Cage 1	F_6, No. 5	20	546	56.4	441	80.7	249	56.4	July 13	July 18
Cage 2	F_6, No. 5	20	584	59.9	558	95.5	345	61.8	July 19	July 27
	Totals and averages	40	1130	58.1	999	88.1	594	59.1		
Cage 1	Grimm 1	20	233	4.1	8	3.04	6	75	July 13	July 18
Cage 2	Grimm 2	20	378	5.5	3	.79	2	66.6	July 19	July 27
	Totals and averages	40	641	4.8	11	1.91	8	70.8		

TABLE 5.—*The effect of tripping on the fertility of the flowers of plants which have a varying percentage of flowers with the self-tripping habit.*

No. of Plant	FLOWERS CAGED						FLOWERS EXPOSED					
	Not hand tripped			Hand tripped			Not hand tripped			Hand tripped		
	No. of flowers	No. of pods	Per cent fertile	No. of flowers	No. of pods	Per cent fertile	No. of flowers	No. of pods	Per cent fertile	No. of flowers	No. of pods	Per cent fertile
F_7 (43)	236	76	32.2	172	49	28.4	207	80	38.6	155	54	34.8
F_7 (119)	121	37	30.5	133	53	39.8	134	55	41.0	127	70	55.1
F_7 (120)	127	24	18.9	167	45	26.9	142	34	23.9	139	41	29.5
F_7 (157)	124	25	20.1	114	39	34.2	132	28	21.2	134	55	41.0
Totals and per cent of totals	608	162	26.6	586	186	31.7	615	197	32.0	555	220	39.6

matic tripping flowers. As was found in F_6, some of the plants which produced the greatest percentage of self-tripping flowers were usually marked by a high degree of sterility. A few plants were found having a fair percentage of fertile flowers.

The results of a test made in 1927 on four plants to determine the percentage of self-tripping fertile flowers are given in Table 5.

The average results given in Table 5 show that when the flowers were hand-tripped and protected from the visits of insects by means of a muslin cage, there was an increase of 5.1 per cent over the caged flowers which were similarly treated but not hand-tripped. When the flowers were exposed to natural conditions and hand-tripped, an average increase of 7.6 per cent in fertility was found in favor of hand-tripped flowers as compared with those under similar conditions but not hand-tripped. This comparatively small increase due to hand-tripping the flowers on these selected plants which produce a fair percentage of self-tripping flowers may now be compared with the effect of tripping normal alfalfa flowers. (See Table 6).

TABLE 6.—*The comparative results of the effects of hand tripping.*

A. On normal alfalfa flowers when caged and also when exposed to natural conditions.

B. On hybrid alfalfa flowers when a percentage of the flowers are self-tripping and treated in a similar manner to the flowers in A.

Treatment of Flowers	A Flowers from normal alfalfa		Average increase due to hand tripping	B Flowers from self-tripping alfalfa		Average increase due to hand tripping
	Flowers tested during 4 years	Per cent pods produced	Group A	Flowers tested 1 year	Per cent pods produced	Group B
Flowers caged and not tripped by hand	3890	12.8		608	26.6	
Flowers caged and tripped by hand	3424	46.5	31.7%	586	31.7	5.1%
Flowers exposed and not tripped by hand	3101	26.4		615	32.0	
Flowers exposed and tripped by hand	2772	46.8	20.4%	555	39.6	7.6%

On comparing the fertility of the flowers in the two groups A, Normal flowers, B, Abnormal self-tripping flowers, it will be noticed:

1. When flowers are caged and not hand-tripped, the fertility of Group B over Group A is more than doubled.
2. When flowers are caged and hand-tripped, the fertility in Group A is increased over 30 per cent as compared with slightly over 5 per cent increase in Group B.
3. When flowers are exposed and not hand-tripped, the fertility is over 5 per cent in favor of Group B.
4. When flowers are exposed and hand-tripped, the fertility in Group A increases to the extent of more than 7 per cent over Group B.

From these results the inference may be drawn that lack of fertility in normal alfalfa is mainly due to the flowers not being tripped, and in those hybrid plants which produce a fair percentage of self-tripping fertile flowers the necessity for hand-tripping is not so essential to induce seed to set; hence the comparatively slight increase due to hand-tripping the plants which produce self-tripping flowers.

The reduced fertility in hand-tripped hybrids as compared with similarly treated normal plants would seem to be due to what might be termed inherent partial sterility due to the hybrid nature of the plants. Since this inherent sterility seems to be decreasing in successive generations we have reason to hope that in due time it will gradually become less evident if not entirely eliminated.

Structural Peculiarities Found in Hybrid Flowers.

The abnormal peculiarities of the floral parts found in the flowers of the first generation plants have been briefly described; a general description has also been given of the structure of abnormal flowers which appeared in plants found in the third and fourth generations. In the later generations, when floral abnormality seemed to become more prevalent, it was thought desirable to see whether or not any relation between abnormal flower structure and sterility could be established.

With this in view a more complete system of dissecting and examining the flowers was commenced. In the flowers examined it was found that the parts which seemed to vary most from normal were the pistils and stamens and especially the pistils; quite a large percentage of the plants had flowers with two pistils and a smaller number produced many flowers having three pistils. This abnormality in the reproductive organs seemed to be usually associated with the self-tripping habit.

A summary of the results of this work is given in Table 7.

In analyzing the results given in Table 7, it will be seen that in the flowers of the first group of plants, numbered 1 to 8, we have in each case the normal number of pistils. With two exceptions (those numbered 2 and 5) these eight plants were all good seed producers. In the remaining hybrids, numbered from 9 to 22 inclusive, we find three plants (Nos. 15, 16, 17) that are absolutely sterile. Plant No. 15 out of thirty flowers had only one normal flower, which is equal to nearly 97 per cent flowers with either two or three pistils. In plant 16 all the flowers had more than one pistil and No. 17 had 25 per cent with either two or three pistils. Four of the remaining plants in this group vary greatly as to the percentage of abnormal flowers. No. 9 gives five per cent, No. 12 fifteen per cent, No. 14 two and one half per cent and No. 18 forty per cent of flowers with more than the normal number of pistils. In spite of the abnormal condition in these flowers (seen particularly in No. 18) all these plants are scored as having high seed producing properties.

These results would lead one to suppose that, though there appears to be a certain amount of compatibility between the set of conditions which cause absolute sterility and those which account for floral abnormality, those conditions which are answerable for the promotion of fertility are gradually gaining ground and may in course of later generations attain to complete

TABLE 7.—*The variability in number of pistils in hybrid plants as compared with the Alfalfa and Black Medick parents. The quality of pollen supply and seeding properties is also given for some of the hybrid plants.*

Plant No.	2a-7S-18S-40-15ct = (F_4) Pedigree numbers	No. of Racemes	No. of Flowers examined	Flowers with one pistil	Flowers with two pistils	Flowers with three pistils	Per cent of Flowers with (a) Good to excellent pollen	Per cent of Flowers with (b) Very poor to fair pollen	Seeding properties estimated 0–10
1	F_4 –11–5/24	8	40	40			*	*	10
2	" –11c–19/25	5	20	20			45	55	few pods
3	" –11–5cn–60	4	20	20			85	15	10
4	" –11–5cn–119	4	20	20			60	40	8
5	" " " –131	5	20	20			55	45	§
6	" " " –159	5	20	20			35	65	7
7	" " " –163	2	20	20			*	*	9
8	" " " –173	5	20	20			75	25	8
9	" " " – 43	4	20	19	1		25	75	10
10	" " " – 73	3	24	20	4		*	*	§
11	" " " – 76	5	20	19	1		50	50	6
12	" " " –132	5	20	17	3		80	20	10
13	" " " –177	3	32	30	2		*	*	§
14	" " " –206	5	40	39	1		75	25	10
15	" " " -row	4	30	1	3	26	*	*	0sterile
16	" " " – 19	10	40	0	3	37		100	0 "
17	" " " – 22	5	32	24	6	2	*	*	0 "
18	" " " –118	5	20	12	7	1	55	45	10
19	" –11–5/25	5	20	14	5	1		100	§
20	" –11–17/25	5	20	13	5	2		100	§
21	F_3 –15ct	6	25	23	2		*	*	
22	" –11	10	40	39	1		*	*	
23	Alfalfa (Grimm)	4	20	20			*	*	3
24	Black Medick	23	85	82	3†		*	*	10
		140	670						
Summary of hybrid flowers (1–22)	Totals		565	450	44	69			
	Percent			79.6%	7.7%	12.2%			

* Pollen supply not determined.
† All from same raceme.
§ Seeding properties not determined.

ascendancy, thus resulting in a progeny which is both abnormal in structure of flowers, self-tripping in habit, and yet highly fertile.

Of the remaining plants in Table 7, the twenty flowers of Grimm alfalfa did not show any abnormality in any part of the flower. The statement may here be placed on record that, after having examined many thousands of individual alfalfa flowers produced from Grimm and other well known commercial strains, the author has occasionally found flowers with a shortened undeveloped pistil but has not yet found a single flower which had more than one pistil. From our observations it would appear that the flowers of Black Medick (No. 24) are not so stable in respect to the development of a single pistil as is the case with ordinary strains of alfalfa.

The Black Medick flowers used for these experiments were collected at random from volunteer plants found growing in a crop of orchard grass. The 85 flowers examined were contained in 23 flower heads; 22 of these heads produced flowers having only one pistil per flower and the remaining head, in which five flowers were examined, proved to have three flowers with two pistils per flower. All the flower heads having been collected in a haphazard fashion we had no means of knowing from which plant any particular head had been gathered and so unfortunately were unable to trace the plant which gave rise to the three abnormal flowers. This finding of 3.5 per cent of the flowers of Black Medick to have an abnormal number of pistils would seem to furnish further evidence that the alfalfa Black Medick hybrids had inherited not only some of the self-tripping characteristics of the Black Medick parent but also a tendency to variability in the number of pistils in the hybrid flowers. (Text Figs. 6, 7).

In addition to the observations recorded in Table 7, measurements were taken, on a somewhat limited number of flowers, of the length of both pistils and stamens. These measurements were made for the purpose of ascertaining what relationship the length of pistils and stamens in hybrid flowers had to similar organs found in alfalfa and Black Medick.

The results are given in Table 8.

TABLE 8.—*Measurements for the purpose of comparing the lengths of pistils and stamens in Grimm alfalfa, Black Medick and five alfalfa Black Medick hybrids in F_4, F_5, F_6, F_7 generations.*

Number of Plants tested 1927		No. of Racemes	No. of Flowers	Pistils	Stamens	
				Average length mm.	Longest length mm.	Shortest length mm.
23	Grimm alfalfa	4	20	7.0	7.47	6.57
24	Black Medick	23	85	1.05	1.29	.97
21	F_4 No. 15ct Sterile	6	25	4.1	5.7	4.4
22	F_5 No. 11 poor seeder	7	20	5.20	5.95	4.55
1	F_6 No. 5 good seeder	5	20	5.45	6.22	4.85
14	F_7 No. 206 good seeder	5	20	5.45	6.05	4.57
16	F_7 No. 19 Sterile	5	20	3.77	5.10	3.75

Since the length of stamens in both alfalfa and Black Medick may vary considerably in the same flower, the length of pistil will be taken for purposes of comparison. If the average length of the pistil of alfalfa (No. 23) and Black Medick (No. 24) be compared, a good idea will be obtained of the relative size of their flowers as a whole.

The flowers from the hybrids in two cases (21 and 16) produced pistils with an average length, only a small fraction (.08 mm.) below that of the mean of the two parents alfalfa and Black Medick. It is noticeable also that the flowers of these plants were completely sterile.

In the hybrids Nos. 22, 1, 14 it will be seen that pistils had lengthened considerably and averaged 1.34 mm. greater in length than the mean of the two parents, but were still appreciably shorter than the average length of the alfalfa pistil. The flowers of these plants proved to have a high degree of fertility.

TEXT FIGURE 6. Flowers and foliage of Black Medick (enlarged).

TEXT FIGURE 7. Hybrid alfalfa racemes A.B., 100 per cent of flowers self-tripped. Raceme C, normal flowers.

Structural Variability in Seedlings in Relation to Floral Abnormality.

In addition to variations in structure and mechanism of the flowers of these hybrids, many observations have been made from time to time on variations which have appeared in very young seedling plants.

When raising hybrid plants in the greenhouse our general practice has been to germinate the seeds in small dishes of porous earthenware; then as the seeds germinate they are picked out and transferred to sterilized soil in flats. *(12)*

This system of treatment allows of notes being made of any peculiarity that may be seen in seeds at the time of germination. During the course of the work of germinating and making observations on over ten thousand seeds very few have been noticed to produce more than one plant per seed. *(13)*

Variations in hybrid seedlings appeared quite frequently and seemed to be especially numerous in the progeny of plants producing a high percentage of abnormal self-tripping flowers. Though this variability in seedlings is often found associated with abnormal flowers, one plant appeared (F_4—11) in which the flowers showed but slight deviation from the normal, while there were many variations in the seedlings. Table 9 shows the results of a definite count of the number of variable seedlings found in the progeny of two hybrid plants.

Table 9.—*The contrast between variability in flowers and seedlings from the same mother plant.*

Variation in Seedlings	Plant F_4 - 11		Plant F_5 - 47	
	Seedlings total	per cent abnormal	Seedlings total	per cent abnormal
Total number of seedlings	60		221	
Seedlings normal	41		167	
Seedlings abnormal	19	31.6	54	29.0
Variation in Flowers	**Flowers total**	**per cent abnormal**	**Flowers total**	**per cent abnormal**
Total number of flowers	40			
Normal with 1 pistil	39			
Abnormal with two pistils in (F-11)	1	2.5	*	*55.0

*Percentage of abnormal self tripping flowers estimated from total flowers on plant F_5 - 47.

In Table 9 it will be seen that in plant F_4–11 the percentage of abnormal seedlings was found to be over 31 while the percentage of flowers with more than the normal number of pistils was only 2.5. With plant F_5–47 (progeny of F_4–11) the percentage of variable seedlings was 2.6 below that of the parent; yet the percentage of abnormal self-tripping flowers in F_5–47 increased greatly and was estimated at 55 per cent or over 52 per cent greater variability than the parent. So that while it seems to be the case that variations in seedlings and flowers seem to be more or less associated they do not appear to have any noticeable correlation.

Additional Lines of Investigation.

During the course of the investigations as reported above from 1916 to 1927 many hybrid plants, progeny of the 2^a cross, were back-crossed with pollen from each parental species; intercrossing between selected hybrid plants was also carried on quite extensively. This back-crossing and intercrossing resulted in a maze of variability both in habit of growth, hardiness, structure of flowers and fertility. Many of the variations were of considerable scientific interest but only a few plants appeared which seemed to have superior economic value and some of the most promising of these are still under test.

Another cross between Alfalfa and Black Medick was obtained in 1913 but after working several years and finding that the plants were prostrate in habit, of very poor quality for forage, and unusually low in seed production, selection work with this line was finally discontinued.

The total number of artificial crosses of various kinds made since 1916 amounts to over 2600 and while many of these crosses were sterile a fair proportion produced a few seeds; altogether more than 10,300 individual hybrid plants have been raised and studied, in addition to row tests of the most promising selections. This special work with hybrids being supplemented by straight selection from commercial strains of alfalfa afforded an opportunity for a comparative study of the possibilities of selection alone as against hybridization and selection.

Summary.

1. Judging from the results of various investigations with reference to the production of alfalfa seed it would seem that, other conditions being favorable, the failure to secure a properly balanced supply of soil and atmospheric moisture is probably the real cause of alfalfa flowers refusing to set seed.

2. By following a well-designed and properly conducted system of individual plant selection, improved strains of alfalfa may be isolated which are more reliable in producing profitable crops of seed than the ordinary commercial strains from which the selections were first obtained.

3. Experiments conducted in widely different areas show that if alfalfa flowers are not tripped either naturally (chiefly by wild bees) or by hand-tripping, only a small percentage of the flowers produce seed pods.

4. If seed production is dependent upon alfalfa flowers tripping naturally and if in certain seasons conditions are such as to greatly reduce the amount of natural tripping which takes place, it would seem desirable that a strain of alfalfa be developed which, under normal conditions, is self-tripped.

5. In order to try and produce the type of plant desired, Black Medick (*M. lupulina*), which normally has self-tripping flowers, was crossed with alfalfa, and the resulting hybrids carried through by successive stages to the seventh generation.

6. In F_1 and F_2 hybrids there was great variability but only poor seed production. In F_3 several good seed producing plants appeared.

7. Seed from the best seed-yielding plant in F_3 was used to raise plants of F_4. In this generation one plant appeared with self-tripping flowers, but as this plant proved to be sterile it was reproduced by means of cuttings and these plants, raised by vegetative propagation, produced a few seeds which were used to raise a crop of F_5 plants.

8. In the F_5 crop the self-tripping habit seemed to be largely suppressed but one plant was found in which the stamens tended to push their way out of the closed keel of the flower. Seeds from this plant were used to produce the sixth generation.

9. In F_6 fifteen plants were noticed which had many self-tripping flowers. Three of these which appeared to be entirely self-tripping were totally sterile. One plant was found which produced over 88 per cent of self-tripped flowers and over 59 per cent of these flowers were fertile. A crop of the seventh generation was raised from seed from this plant.

10. As a general rule when the flowers on a particular plant were found to be completely self-tripping the plant was either totally sterile or produced but very few seeds. A few plants have appeared with a good percentage of self-tripping flowers together with a high degree of fertility.

11. Seed from self-tripping flowers usually produced a large percentage of seedlings having various structural variations from the normal, but there did not seem to be any definite correlation between the variability in flowers and seedlings.

12. Many experiments were made in back-crossing the hybrids of different generations to each parental species; intercrossing between selected hybrid plants was also practised. In this work a few excellent plants were obtained, but the possibility of ultimately producing a self-tripping fertile strain of alfalfa seemed to lie in the direction of following up repeated selections from the original 2^a cross.

13. Evidence has been furnished to show that a hybrid alfalfa has been produced in which a varying percentage of the plants have flowers which are practically entirely self-tripping but largely sterile; also plants are found which are partially self-tripping and partially fertile. As sterility appears to be gradually giving place to fertility in recent generations there is reason to hope that eventually a strain will be evolved having flowers perfectly self-tripping and also possessing a high degree of fertility.

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Plate I

Figures 1-6. First generation plants of cross 2. Specimen plants from each of the five seed pods viz:—a, b, c, d, e. Note variability in plants 2a – 4 and 2a – 7, produced from seeds out of same pod. 2a – 7 is the foundation plant of the hybrids concerned with the investigations explained in the present article.

PLATE II

Hybrid Seedlings:

Variability in alfalfa ♀ × ♂ Black Medick (cross 2) hybrid seedlings. No. 1, Normal seedling; Nos. 2, 3, 4, Abnormal seedlings; Nos. 5, 6, 7, 8, abnormal foliage leaves of seedlings.

PHYSIOLOGIC FORMS OF OAT STEM RUST IN CANADA*

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Introduction

When an extensive programme of grain rust research was undertaken in 1925 by the Dominion Department of Agriculture, added attention was given to the oat stem rust problem. This work was centered at the Dominion Rust Research Laboratory, Winnipeg. It was considered essential to obtain as much information as possible concerning the physiologic forms of oat stem rust in Canada before an adequate plant breeding programme could be undertaken.

Oat stem rust is more or less injurious in certain areas every year, but it was extremely serious in 1927, especially in Manitoba. In Western Canada, it usually appears first during the season in southern Manitoba about the first week of July. It soon attains epidemic proportions if conditions are suitable for its spread.

The work herein reported has been carried on since 1925 at the Dominion Rust Research Laboratory, Winnipeg. Previous to the above date, physiologic forms had been identified from only a very limited number of oat stem rust collections from Canada. Since then, greater facilities have been available for carrying on the work and more extensive rust surveys have been carried out each year. Members of the Dominion Laboratories of Plant Pathology have assisted greatly in the work by sending in numerous collections of rust.

Historical

The existence of physiologic specialization in *Puccinia graminis avenae* Erikss. and Henn., was first demonstrated by Stakman, Levine and Bailey (*1*) in 1923. In 1924, Bailey (*2*) reported definitely the occurrence of five physiologic forms. Forms 1, 2 and 5, were collected from widely separated points in the United States and Canada. Form 3 was obtained only in collections from Sweden and South Africa, and Form 4 was represented by a single collection from Sweden. Forms 1, 2 and 5, were isolated again by Bailey (*3*) in 1924, from a total of 26 collections made in Canada.

Methods

Collections of oat stem rust were made during the summer from the first appearance of the rust, until the end of the season. The majority of those obtained were on *Avena sativa* L. and *A. fatua* L. An occasional collection has been made on the barberry and on the grass hosts, *Dactylis glomerata* L. and *Torresia odorata* (L) Hitch.

All the work dealing with the identification of the physiologic forms was carried on in the greenhouse. The rust was first transferred to seedling plants of the Victory variety, which is susceptible to all the known physio-

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logic forms of *Puccinia graminis avenae*. Inoculum from this variety was then used to infect the differential hosts. The varieties or strains of oats which Bailey (*2*) found to be differential in their reaction, were used in this work. (Table 1). The physiologic forms were identified according to Bailey's Key (*2*).

TABLE 1.—*Reaction of differential hosts to physiologic forms of Puccinia graminis avenae*

Form	White Russian	Richland, Heigira Strain, Monarch Strain	Joanette Strain Strain 703	Victory
1	3c	2	1	4
2	3c	2	4	4
3	4	2	1	4
4	4	4	1	4
5	3c	2	×	4
6	4	4	4	4

ORIGIN OF COLLECTIONS

The majority of the oat stem rust collections identified each year were obtained from Manitoba and Saskatchewan (Table 2). Collections were obtained from Alberta and British Columbia only in 1927. A few collections have been available from Eastern Canada each year, chiefly from points where the Uniform Rust Nurseries were located (Figs. 5, 6, 7). A list of the localities in which rust was collected in 1925 is given in the Report of the Dominion Botanist for the year 1926. Similar data of the collections made in 1926 and 1927 will be published at a later date.

PHYSIOLOGICAL FORMS ISOLATED

In Table 2 is shown the number of collections made in each Province and the physiologic forms which were isolated from them. In Tables 4, 5 and 6, is shown the number of isolations of each physiologic form from the different Provinces in 1925, 1926, and 1927.

TABLE 2.

Province	1925		1926		1927	
	Number Collections	Forms Isolated	Number Collections	Forms Isolated	Number Collections	Forms Isolated
British Columbia	—	—	—	—	1	2,5
Alberta	—	—	—	—	45	1,2,5,
Saskatchewan	11	2,3,4,5,6	64	1,2,4,5	143	1,2,4,5
Manitoba	39	1,2,5	88	1,2,4,5,6	115	1,2,4,5,6
Ontario	3	2,	11	2,4,5	18	2,5
Quebec	3	2,5	9	2,5	9	1,2,5
New Brunswick	2	2,5	10	2,5	3	2,5
Nova Scotia	1	2,	5	5,	9	2,5
Prince Ed. Island	1	5,	5	5.	1	4,
Total Collections	60		192		344	
Physiologic Forms isolated in Canada		1,2,3,4,5,6		1,2,4,5,6		1,2,4,5,6

Physiologic Forms 2 and 5 have predominated each year. They comprise 95 per cent or more, of the total isolations, and both are widespread in Canada. The comparative frequency of occurrence of the physiologic forms is shown in Fig. 1.

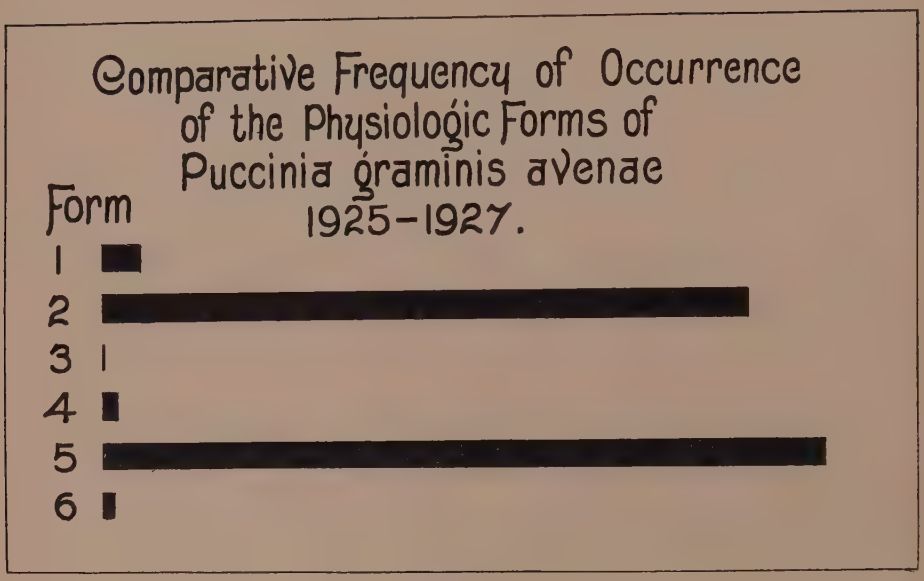

FIGURE 1

OCCURRENCE OF VIRULENT PHYSIOLOGIC FORMS OF *Puccinia graminis avenae*.

Previous to 1925, no physiologic forms were collected in Canada capable of infecting heavily the differential hosts, White Russian and the Richland group of differentials (Richland, Heigira Strain, and Monarch Strain). During 1925, however, collections of oat stem rust obtained from three more or less widely separated points in Saskatchewan, contained forms more virulent than the common Physiologic Forms 1, 2 and 5. Since then, virulent physiologic forms have appeared each year. Data concerning the collections and the forms isolated from them are presented in Table 3.

TABLE 3.—*Data concerning the collections of virulent physiologic forms of Puccinia graminis avenae in Canada.*

Rust Survey Number	Place of Collection	Date Collected	Physiologic Form	Host
		1925		
1	Paskwegin, Sask.	4–8	6	A. fatua
19	Indian Head, Sask.	14–8	4	A. sativa
40	Fairlight, Sask.	14–8	3 & 4	"
		1926		
63	Weyburn, Sask.	31–7	4	A. sativa
70	Pine River, Man.	5–8	4	A. fatua
78	McCreary, Man.	4–8	6	A. sativa
108	Winchester, Ont.	26–8	4	"
		1927		
6	Charlottetown, P.E.I.	7–7	4	Barberry
7	St. Jean, Man.	11–7	4 & 6	A. fatua
26	Wawanesa, Man.	17–7	4	"
130	Cartwright, Man.	7–8	4	A. sativa
136	Indian Head, Sask.	4–8	4	"

The most interesting and important physiologic form is the one collected for the first time at Paskwegin, Sask., in 1925. It was found to be capable of infecting heavily, all the differential hosts, which made it the most virulent form yet isolated. Its infection capabilities differ from all the other forms of *Puccinia graminis avenae,* so it is considered a new form and has been named Physiologic Form 6. Only three collections of this form have been obtained,—two from Manitoba and one from Saskatchewan. The typical reaction of all the differential hosts to this form is shown in Fig. 2. Form 4 has been collected ten times.

FIG. 2. The typical reaction of all the differential hosts to Physiologic Form 6.

This form was previously known to occur only in Sweden (*2*). Form 3 has been isolated once. These physiologic forms, although more virulent than Forms 1, 2, and 5, have been collected comparatively rarely.

THE HETEROGENEOUS OR X REACTION

Physiologic Form 5, one of the most frequently occurring forms, gives a heterogeneous or X reaction on two differential hosts, Joanette Strain and Strain 703 which react as a unit (Table 1). That is, on a single plant pustules may occur, varying from an extremely resistant type to an entirely susceptible type. Repeated attempts to make separations from any one type of pustule, result in the final production of the heterogeneous or X reaction again. Apparently the ordinary method of separation used when two or more physiologic forms are present on the same leaf is of little value in such cases.

Early in 1926, a study of this type of reaction was made by the single spore method. Spores from a culture giving an X reaction were thinly scattered on a sterile glass slide. The slide was then placed under the low

power of a compound microscope. Single spores were picked up by means of a sharp pointed needle, on the point of which was placed a very small amount of vaseline. The point of the needle was again examined under the microscope to be certain that only one spore was attached. The single spore was then placed on a leaf which had been previously moistened, after which the needle was sterilized before another spore was picked up.

About eight plants per pot were inoculated in this manner. These were enclosed by a glass cylinder on the top of which was placed a moist sheet of blotting paper. The pots were then placed in the ordinary moist chambers for 48 hours, when they were removed and placed on a bench in the greenhouse in a compartment made of cotton sheeting..

Only about two per cent of the plants inoculated with a single spore ever produced a pustule.

From a pustule produced from a single spore 62 plants, 27 of Joanette Strain and 35 of Strain 703, were inoculated. It was found possible to inoculate this many plants from a single pustule, by inoculating a few plants in intervals of about four days. It was interesting to find that the X reaction appeared on all of the 62 plants on the first transfer (Figs. 3 and 4 show the reaction of a number of the plants). Further single spore cultures of Form 5 produced additional evidence that the heterogeneous or X reaction could occur when inoculations were made with them. Additional work will be undertaken on the nature of this type of reaction when conditions in the greenhouse can be more adequately controlled.

Field Tests of Oat Varieties to Physiologic Forms

In the spring of 1926, more than 180 varieties or strains of oats in the Rust Nursery were sprayed with a spore suspension of all the physiologic forms. By the time the plants had headed, a very heavy infection had taken place. It was quite evident on the examination of the varieties or strains, ordinarily resistant in the Rust Nursery to Physiologic Forms 1, 2 and 5, that all were susceptible. Collections made from these varieties, and later identified in the greenhouse, showed that Physiologic Forms 4 and 6 were apparently responsible for their susceptibility.

Seedling Tests of Oat Varieties to Physiologic Forms 4 and 6.

Seedling tests of oat varieties for rust resistance were carried on in the greenhouse early in 1927, in the hope of obtaining a variety or strain resistant to Form 6. Some 230 varieties or strains of oats, obtained from various sources in Canada and the United States, were inoculated in the seedling stage. These varieties were tested also to Form 4 at the same time. All appeared to be quite susceptible to both physiologic forms.

As none of the varieties available in America showed any resistance, 100 additional ones were obtained through the courtesy of the Dominion Botanist, H. T. Güssow, from France, Germany, Sweden and Russia. It was discouraging to find that all were apparently susceptible to Form 6, and only one variety from France showed any resistance to Form 4.

FIG. 3. The heterogeneous or X reaction of Joanette Strain produced as a result of inoculation with a single spore culture of Form 5.

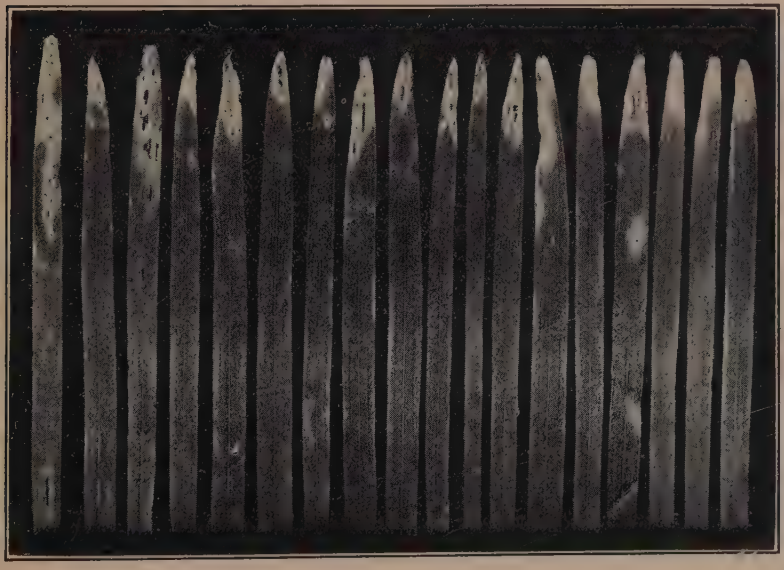

FIG. 4. The heterogeneous or X reaction of Strain 703 produced as a result of inoculation with a single spore culture of Form 5.

Form 6 appears to be exceedingly virulent. Nothing inoculated with it, to the present time, offers anything of value. The differential hosts, Joanette Strain and Strain 703, are the only strains of oats possessing a high degree of resistance to Form 4.

Summary.

1. Six physiologic forms have been isolated in Canada during the period 1925-1927.
2. Physiologic Forms 2 and 5 have predominated each year.
3. Forms 3 and 4 are reported for the first time as occurring in Canada.
4. Form 6 is reported as a new physiologic form.
5. The heterogeneous or X reaction, given by Form 5 on Joanette Strain and Strain 703, is shown to occur from single spore cultures.
6. Tests of numerous oat varieties have shown the extreme virulence of Forms 4 and 6.

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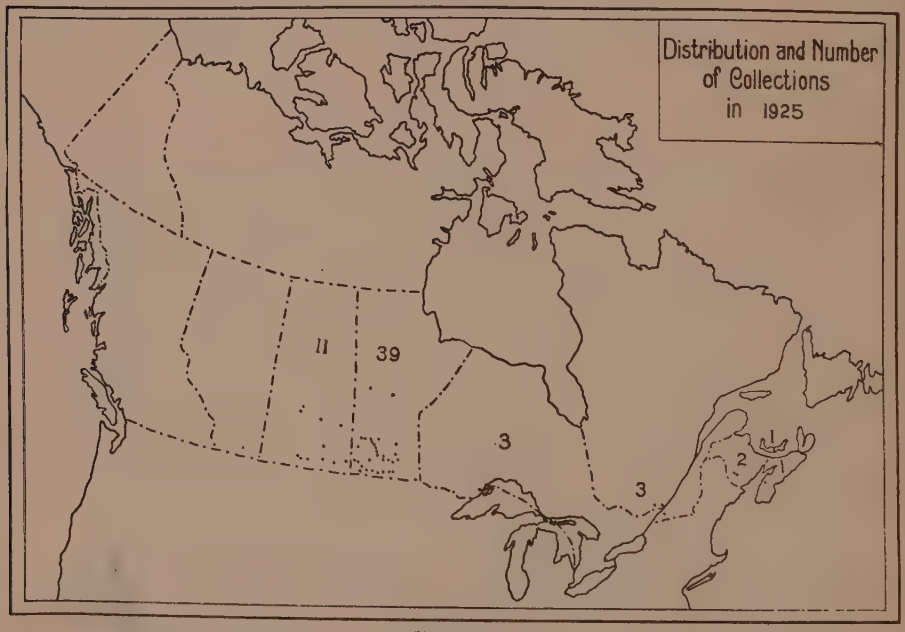

Figure 5

Table 4.—*Distribution of physiologic forms in 1925.*

Ferm	B.C.	Alta.	Sask.	Man.	Ont.	P.Q.	N.B.	N.S.	P.E.I.	Total Isolations
1	—	—	—	2	—	—	—	—	—	2
2	—	—	7	19	3	2	1	1	—	33
3	—	—	1	—	—	—	—	—	—	1
4	—	—	2	—	—	—	—	—	—	2
5	—	—	2	26	—	1	1	—	1	31
6	—	—	1	—	—	—	—	—	—	1

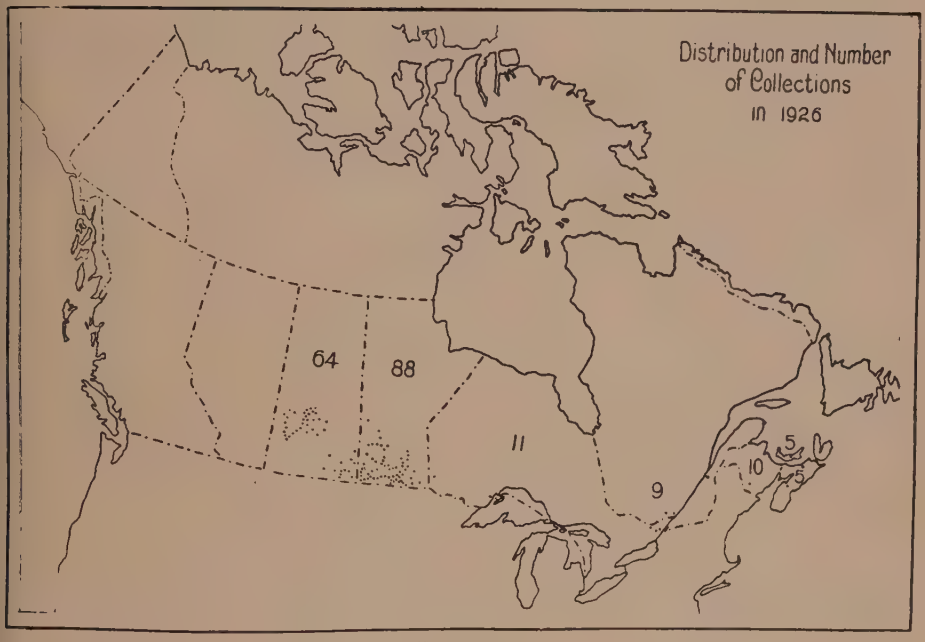

FIGURE 6

TABLE 5.—*Distribution of physiologic forms in 1926.*

Form	B.C.	Alta.	Sask.	Man.	Ont.	P.Q.	N.B.	N.S.	P.E.I.	Total Isolations
1	—	—	1	2	—	—	—	—	—	3
2	—	—	31	35	5	4	4	—	—	79
3	—	—	—	—	—	—	—	—	—	—
4	—	—	1	1	1	—	—	—	—	3
5	—	—	45	66	8	6	9	5	5	144
6	—	—	—	1	—	—	—	—	—	1

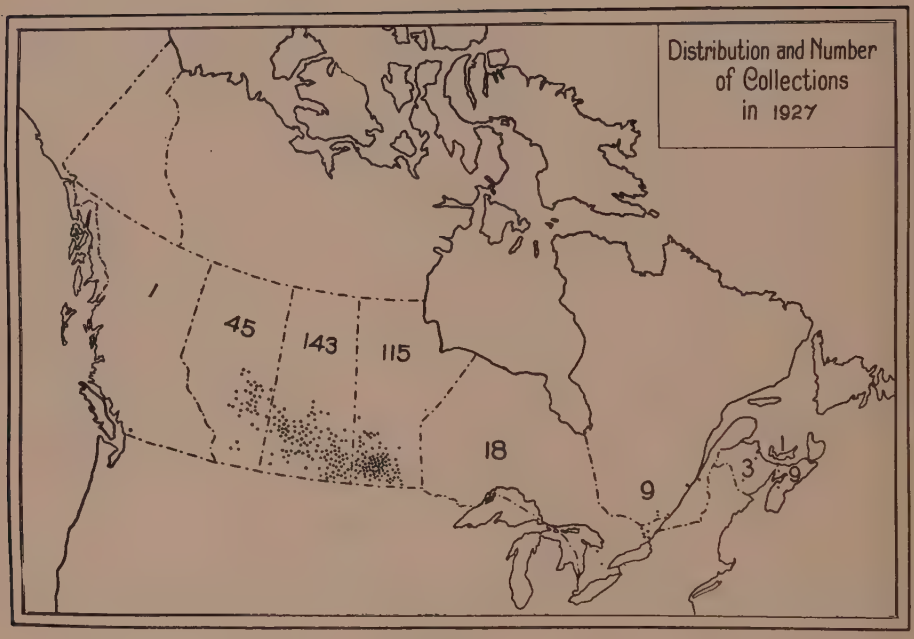

FIGURE 7

TABLE 6.—*Distribution of physiologic forms in 1927.*

Form	B.C.	Alta.	Sask.	Man.	Ont.	P.Q.	N.B.	N.S.	P.E.I.	Total Isolations
1	—	2	3	4	—	1	—	—	—	10
2	1	16	59	56	12	2	1	4	—	151
3	—	—	—	—	—	—	—	—	—	—
4	—	—	1	3	—	—	—	—	1	5
5	1	35	95	68	7	7	3	5	—	221
6	—	—	—	1	—	—	—	—	—	1

REPORT OF C.S.T.A. COMMITTEE ON MARKETING EDUCATION*

F. M. Clement, Chairman†
University of British Columbia, Vancouver, B.C.

Three reports to date have been made by the Committee on Marketing Education. The first of these made by Professor A. Leitch, Chairman, dealt mainly with fundamentals prerequisite to marketing courses and with some of the subject matter of marketing courses. Another made by Mr. A. A. MacMillan, Chairman, dealt largely with departmental activities, Dominion and Provincial, in relation to promotion work and made specific recommendations with regard to marketing courses (Page 435, *Scientific Agriculture,* August 1926). In the absence of the Chairman at the Annual Convention in Vancouver, 1927, I was asked as a member of the committee to make a short report. This was done verbally and a summary of my statement appears on Page 476, *Scientific Agriculture,* August, 1927.

The committee for this year consists of E. A. Howes, W. J. Rutherford, W. C. McKillican, J. B. Reynolds, H. Barton, Rev. Father Leopold, l'Abbé Noel Pelletier, J. M. Trueman, A. A. MacMillan, P. E. Light. I was asked to act as Chairman.

A letter was addressed to all members of the Committee asking for the names of men in the respective Provinces who were most likely in a position to be of assistance to the Committee. The questionnaire was sent to 106 names on this list. Thirty-one replies were received. Although the total percentage of replies seems low, it should be pointed out that in a number of cases two or more and in some instances groups of men collaborated in the preparation of answers. Many of the replies are representative of considered collective opinion and consequently have very considerable value. Many individual replies were very carefully prepared.

If one were to accept as gospel truth all that all have said, to arrive at conclusions would be an impossibility, but by careful reading and proper selection, one may hope to arrive at sane conclusions as to the opinions of the greater number and by the same token pay due respect to the expressed opinions of the more lonely voices, and in some cases those lonely voices seem to arrive at the clearest conclusions.

Three types of men replied to the questionnaire: University men, Government officials, and what may be called the business men. In no type is there a related common strain in the answers as a whole. Of course, in some cases it may be said that the University men are too academic, that the business men are too practical and that the officials are too cautionary, but such a criticism in itself means little. Thus rather have the replies been treated as replies regardless of the writers' positions in the economic order, but at the same time any little samenesses that might be the result of position have been noted.

*Presented at the Eighth Annual Convention of the Canadian Society of Technical Agriculturists, Quebec, P.Q., June 11, 1928.

†Dean of the Faculty of Agriculture.

1. College Education in Marketing.

(a) *"As an introduction to the subject, what type of course should be offered—a general course based on Economics or a specific course based on descriptive marketing work in livestock, fruits, eggs, and other commodities?"*

The answers to the above question may be divided into three. First, that of a general course based on Economics. It is perhaps worthy of note that every University Professor who answered this question comes within this group. Of the rest of the replies of like nature, only one may be said to come from a business man. The following is a typical reply to this question:

"I consider that a good general course in Economics is the best introduction to college education in marketing."

In the second place come the advocates of the specific course based on descriptive marketing work. Of the three men urging the adoption of such a course two were business men and the other was a Government official. One says:

"I would favor a regular marketing course at our Agricultural Colleges, with specific training along commodity lines."

In the third place come those men who considered that neither of the above two courses would suffice in themselves. They were all for the compromise route. To quote:

"In my opinion, no course is really complete without the teaching at the same time of the cause, the reason and the wherefore of all things.

"If one has only a general course based on Economics, the pupil will have nothing else but the theory and will have no idea whatever of the practice, and vice versa. That is why I believe that one shall instill the pupil first with the fundamental principles of Economics; then give him a good developed course (specific) on descriptive marketing work in the different commodities."

(b) *"What type of college training would seem to be best adapted to fitting a boy for efficient service in co-operative organizations?"*

A member of a co-operative marketing board says:

"In my answer to this question I shall list the following, which appear to me to be among the most important branches of college training for efficient service in co-operation:

1. A thorough grounding in the principles of Economics, so that the boy can read critically and think logically.
2. A training in the principles of business: office administration, salesmanship, and a study of the channels of commerce and trade.
3. An adequate training in accounting (particularly the principles), so that the student, when he goes into business, will have an appreciation of the importance of this subject and sufficient detail to know how to work out and apply a system suited to the business with which he has to deal.
4. Statistics—price data, use of index numbers, forecasting, etc.
5. Money and banking—theory and practice.
6. Marketing—comprehensive study of the marketing of farm products, both theoretical and descriptive, special attention being given to co-operation and the way in which co-operation improves upon the existing competitive system.
7. Co-operation—Efficient training in the history, principles of co-operation and co-operative philosophy. This course should embrace both consumers' co-operation and producers' co-operation as it is followed in all countries of the world.
8. Co-operative store management—this course should be made elective."

The above suggestions come from a man who took his M.A. in Economics at Wisconsin and who has several years' experience in practical marketing.

Common ground underlies most of the replies to this question, that of practicability.

"Training of a general nature (should be) supplemented by one or more summers' work with co-operatives or with firms where marketing knowledge may be gained at first hand."

And again:

"Students who specialize in marketing and co-operation should be given some credit in their college course provided their summers are spent as employees of co-operative organizations."

And again:

"Study travels that will enable the pupil to study on the spot the organization and the operations of the best co-operatives at work, on condition, however, that the pupil has previously received a good business training together with the fundamental principles in Economics."

And again:

"College training best adapted for fitting the boy for service in co-operative organizations should comprise agriculture and business, that is the agricultural course should be sufficient to acquaint the student with agricultural problems and to gain the active interest of the student in agriculture. With that it is essential that the student receive a thorough course in business practice and principles."

And again:

"Develop another option entitled Agricultural Commerce, and have degree, Bachelor of Commerce in Agriculture (B.C.A.), the course to include as major subjects, economics and business relating to the marketing of agricultural products at home and abroad, and to cover grading and packing of products, transportation, pool selling, etc."

In this connection also:

"Alllied to Marketing would also be courses in Accounting, Statistical Methods, Journalism, and perhaps Public Speaking, particularly where the objective might be to train men for co-operative organizations. It is assumed that men must have knowledge of the technique and technology of agricultural production."

Generally speaking, University Professors were most evasive in their answers to this question and would offer no specific comments.

"Should this training be primarily descriptive or primarily in economic principles, marketing principles, money and banking and similar topics?"

The answers to the first part of this question partly answer this one also but some replies deal more specifically with it and are worth quoting. The upholders of the descriptive course offer no reason for their belief other than that they think it would be the best.

Two men dealing with business aspects state:

"Training should be primarily descriptive and practical, but economic principles, marketing principles, money and banking, and similar topics should have a prominent place in the course."

Ranged on the other side are some leaders in marketing. Thus one says:

"This training should not be primarily descriptive as the descriptive part of the training must of necessity be acquired by practical experience."

And the men from the Maritime Provinces say:

"This training should be primarily in economic principles, marketing principles, money and banking and similar topics. The descriptive side can be readily obtained even after entering marketing organizations. If the college trained man is to prove his worth in marketing organizations, he has got to do it because of his understanding of the underlying principles back of all marketing. The descriptive side is known by hundreds now in the marketing business. The college man cannot hope to make good on his knowledge of this side alone. Rather he has got to bring to the marketing field, such understanding of the principles of economics and of marketing, as will enable him to analyze the marketing problems confronting him."

(c) *"Do you know and can you give examples of marketing organizations or private marketing agencies that are offering any encouragement to the college trained boy?"*

Marketing organizations that are instanced as offering encouragement to the college trained boy are:

The Quaker Oats Company,
Manitoba Wheat Pool,
Manitoba Co-operative Marketing Board,
Central Co-operative Livestock Marketing Association of Manitoba,
Canadian Co-operative Wool Growers' Company,
Dominion Sugar Company, Chatham, Ontario, (in Chemistry).
Maple Leaf Milling Company,
American Agricultural Chemical Company of New York,
Alberta Wheat Pool,
Swifts' Meat Packing Company,
American Cotton Growers' Exchange,
Goodyear Tire and Rubber Company,
Maritime Livestock Marketing Board,
New Brunswick Egg and Poultry Association,
Lower Mainland Potato Control Board of B.C.

This list does not include all. The organizations of Manitoba seem to be the most forward in this respect. "The Manitoba Co-operative Marketing Board offers three scholarships in Economics at the Manitoba Agricultural College." This statement could scarcely be applied to the other Provinces of Canada and is in direct contraposition to the statement of another correspondent, who says:

"At the present time in this Province it is pretty hard to offer any encouragement to a B.S.A. They usually come out of colleges as wild horses, imagining that they know all about farm products and are often looking for government positions. They do not easily follow the directions given by the manager, but they are liable to be a very great help when they want to do good."

A reply from the Maritime is of particular interest in this regard:

"First, we would place research men, men trained in our graduate schools of economics. Such men are being used by the Alberta Wheat Pool, by Swifts in their research department, American Cotton Growers' Exchange, Goodyear Tire and Rubber Company. These men are trained in Principles of Economics and in Statistics. Possibly they cannot be considered as research men in marketing entirely, but their work is the studying of production and marketing problems.

"Field Work—Men engaged in this work do not necessarily have to have the technical training necessary for research men. They must, however, be prepared to develop sentiment among growers along sound economic lines. Failure so to do means trouble for the organization they represent sooner or later. Many of the co-operative marketing failures on this continent are due to the lack of properly trained men in the field work. These men should be grounded in economics, at least those in charge of the work.

"Marketing organizations are constantly taking college men for executive and selling positions. Men for these positions must have had training in other than the technical side of marketing. They must know the actual marketing side as well or they must acquire it."

This answer is of interest from the Manitoba Wheat Pool:

"In the Manitoba Wheat Pool we have a field service. This is of vital importance in our organization work. The field man is all the time in contact with the farmers and the pool members; to them, to a very large extent, he is the Pool, hence the reason why in the field service we should get the very best men possible. The types of men required for this work are not to be picked up every

day or at a moment's notice. If I had to choose between two applicants, one having an agricultural college degree and the other not, I would give the preference to the degree man. Why? Because his college training will have given him a greater insight into the why and wherefore of his work, and makes the difference between working only for the job and salary and working for a cause.

"Some of the qualifications necessary in a field man are:

(a) Character,
(b) Belief in Co-operation,
(c) Farmer's viewpoint,
(d) Power of conviction,
(e) Must be a speaker,
(f) Tact.

"I prefer the agricultural college applicant to the other because he has had teaching and training to speak and debate, to present his ideas, and because he has been given the historical background of the co-operative movement and also of its economics."

"I do not think any teaching is sufficient that deals only with the material or economic aspect of the case; it must include the human with the animal—clothing the body and satisfying the spiritual need. Certainly our colleges in co-operation must teach the economic principles of the non-profit basis, operation at cost and a more equitable distribution of wealth, but they must also teach membership control, and that underlying the whole is a belief that 'each for all and all for each' will create a better world wherein people can dwell in peace and good will."

(d) *"What courses are offered in your Agricultural College at the present time and how might these be improved?"*

Replies to this question were few and far between and then mainly from University Professors so that outside criticism is spared.

One University has "one course on General Principles, two hours a week for seven months; a second course on marketing of the same length and weight. An improvement in the work offered would be a good course in Accountancy as well as courses in money and transportation."

The University of Saskatchewan has "none in this subject as yet".

The courses offered at the University of Manitoba are:

(a)	Principles of Economics	2nd yr.	Total for Student majoring in Economics.
(b)	Farm Management	3rd "	
(c)	Marketing	" "	
(d)	Finance	" "	
(e)	Agricultural Commerce	4th "	
(f)	Co-operation	" "	
(g)	Statistics	" "	
(h)	Land Economics		
(i)	Accounting.		

A comment is offered on the courses at the Manitoba institution, thus:

"Speaking in respect to the courses that have been offered up to the present, I would say that the principal weakness is that of having too many subjects on the calendar, making it impossible to give sufficient time to any one subject. I think also that it would be preferable to give more attention to lecture work."

At the Agricultural School at Ste. Anne de la Pocatière, P.Q., there is an

"elementary course in agricultural economics (which) might be improved by a course in marketing."

At Macdonald College the

"courses at present offered include, 'Principles of Economics', 'Principles of Marketing', and 'Statistics and Prices'."

"The Nova Scotia College of Agriculture gives the first two years only of the degree course and hence teaches no marketing to their men. In the second year farm course.... a practical course in marketing for men who are going back to the farm (is offered). This course could be improved by having available information on the marketing organizations in the Maritimes, their operation, their business methods, and data as to the costs of marketing in the Maritimes."

From New Brunswick comes this statement, "We have no Agricultural College."

A correspondent from the Ontario Agricultural College writes:

"In regard to Marketing, we offer to senior students in the Animal Husbandry, Agronomy, Apiculture, Horticulture and Dairy Options, a course of fifty-two lectures, in which the principles of Marketing are developed."

(e) *"Do you consider a marketing major (similar to Animal Husbandry Major or Agronomy Major) advisable, or should marketing be taught in the departments offering instruction in Livestock, Agronomy, etc.?"*

A number of correspondents favored a marketing major. Only two of these, however, get beyond the stage of saying "that a marketing major is advisable."

One states that he

"certainly would not countenance this subject being taught in any other department of the college,"

While another holds that

"the work should be supplemented by a certain amount of economic instruction, incidental to the subjects of Agronomy and Animal Husbandry."

One Director of Marketing would strongly recommend a marketing major "If there were sufficient marketing organizations to promise employment." But since he does not believe this to be so he favors "the alternative of offering classes in marketing for students in the various departments as at present constituted."

Two others express the opinion that marketing should be taught by the departments offering instruction in Livestock, Agronomy, etc. Another says:

"I do not see the wisdom of a Marketing Major. How to prepare products for market should be a part of the course offered by the various divisions. Vegetable gardening has its particular studies in the preparation for market of the crops grown. Fruit-growing, poultry, livestock and other lines have their particular problems as to the preparation of the products for marketing. We think this phase of the subject cannot be taught to advantage except by the division having to do with it."

There are a number of men who would not approve of either of the two courses above and their concensus of opinion is that expressed by another correspondent who says:

"I do not consider a 'Marketing major' as advisable any more than a 'Swine major' or a 'Beef major' would be advisable. Marketing is, in my estimation, only one division (and at that not the most important) of the larger field of Agricultural Economics. To establish a 'Marketing major' before a major is established in Agricultural Economics is under such conditions not advisable.

"Marketing can scarcely be taught in the Departments of Livestock, Agronomy, etc., for the simple reason that it is unreasonable to expect authorities on these particular lines to be also authorities on Marketing."

Another expressed his opinion in this way:

"Experience, I believe, has shown that marketing cannot be taught by the Animal Husbandry or Agronomy Departments. I am not so sure either, that a major in marketing is sufficient to meet the requirements. Advanced courses in practical subjects such as Animal Husbandry and Field Husbandry are not necessary to an adequate training in marketing. The fact is that students when they have

gone through college find that they have wasted their time on these subjects, and would have liked to have had more time on their specialty. It appears to me that they should have enough groundwork in Animal Husbandry and Field Husbandry to give them a general outline of plant and animal judging and breeding, but that is all. I am inclined to favour a course where the first two years is given over to a thorough training in mathematics, English, the principles of economics and pure science. Then for the last two years there should be a special course in agricultural business, with options in marketing, farm management and business administration. The latter would be included in both the first two mentioned, but if it is chosen as a specialty more attention would be given to such subjects as accounting, statistics and money and banking."

Another sums up the problem in this way:

"First, preparation of the products for the market to be taught in each department offering instructions on a special subject. And second, the sale of such a product to be taught under the Economics Department."

2. SPECIAL COURSES IN MARKETING.

"Would you recommend special short courses in marketing and co-operation for farmers and others?"

Only two dissenting voices were heard with regard to special short courses. One says:

"It seems to me a short course is so limited in time that it does not cover the personnel of the locality sufficiently to make the course of any particular value."

And that is not altogether untrue. The other dissenter is a business man and his objection is really only a half one; thus:

"I would recommend special short courses in marketing but not yet in co-operation. I have been studying co-operative marketing for twenty years . . . . and in my opinion we have yet too much to learn in connection with co-operative marketing for it to be wise for our Agricultural Colleges to establish courses in it at the present time. For the present this work is and should be carried on by the co-operative organizations themselves."

All others who answered this question were in agreement that special short courses in marketing and in co-operation might be good things, although some were careful to begin their statements with such phrases as 'under special conditions' or 'at certain times'.

There is not quite so complete agreement on the question, "For farmers and others". One would have the course go to the farmer, thus:

"Short courses can best be conducted in co-operation with farmers' organizations at local country points. We have not been successful in putting on Marketing Short Courses at the College."

Another would advocate short courses, especially in co-operation because:

"a greater knowledge (of co-operation) would break down a great deal of misunderstanding and opposition, and lead to an automatic understanding of the difficulties with which the co-operative organizations are faced."

Another expresses the opinion that short courses should be:

"not so much for the men engaged in the business of marketing, but rather for the leaders in the movement in the various localities."

This is virtually the opinion expressed also by a representative on the opposite side of the country.

"Who should be the instructors in these courses if organized?"

No particular set of men was selected exclusively to act as instructors. The choices fell upon the following:

1. Men from the Economic Departments of the Universities.
2. Men from Departments of the Universities dealing with particular lines, e.g., fruits, cows, swine, etc.

3. Managers and organizers of co-operatives.
4. Practical business men engaged in marketing.
5. Government Officials, both Federal and Provincial, from the Departments of Agriculture, such as Graders and Inspectors.

What should be the type of work offered?"

One correspondent gives a general opinion when he says:

"The type of work offered should be 'survey courses of the general trend of the whole movement by economic instructors and the dealing with detailed problems by the men engaged in the business'. That is, practice and theory should be co-ordinated and supplementary."

Another advocates:

"(1) General talk on market outlook, co-operation, etc., (2) Problem discussions by local men, prearranged, (3) Practical demonstrations in improving quality."

Another says:

"The courses should deal with (1) Discussion and demonstration of grading farm products, (2) Farm accounting, (3) Rural credits in relation to production, (4) Suitable forms of co-operative organization, (5) Governmental agencies to assist the farmer in buying and selling."

While another would have them deal with:

"(1) Principles of Economics, (2) Principles of Marketing, (3) Possibilities of Co-operation and (4) Limitations of Co-operation."

All that it is possible to say definitely here is that the type of work offered should depend upon the Instructors and the Students in the course.

3. Marketing Education in Relation to Business.

"Can you suggest any means whereby more executives in large organizations might be induced to offer college men opportunities for experience?"

Generally speaking there are four attitudes expressed in the replies to this question: (1) That the college man should be sought after by business for its own sake, (2) That the college man, at present, obtains a position not because of his education but in spite of it, (3) That the University can do something for the employment of its graduates and (4) That no inducement should be needed to help the college man find his place in the economic order.

4. Present Work in Marketing Education.

"What work in marketing education is being done by yourself or others in your department at the present time (all educational and promotion work should be included here)?"

Naturally this question divides itself into the work being done by the three classes of men who answered the questionnaire: University Professors, Government Officials and Business Men. Each seems to have a fairly definite field although overlapping is ever evident and would be hard to avoid even if advisable. Thus the colleges seem well adapted for research and experimentation, the Government Officials for compilation of statistical information and the making of reports, and the co-operative men for the solution of practical problems.

As regards the colleges, information has been given regarding the courses and work in answer to 1 (d); here definite information will be given about some particular institutions. Thus:

"The work being done by myself in this connection is confined to teaching the student what the desired market type of animal is, how he may learn to sel

that type, how he may develop it economically to market age, weight and finish and also how best to prepare and place that particular animal or animal product on the market. Our main interest in Animal Husbandry courses here is to give, emphasize and make clear, the process of economical production and deal with the marketing and rather briefly in our senior year. For students specializing in Animal Husbandry I give a course dealing with the Livestock Exchange, the Stock Yards and operation of same, co-operative selling of livestock, the Livestock Pools, etc., together with a number of lectures on the chilled and frozen meat trade of Argentine, Australia and New Zealand; also the Bacon and Dairy Products trade of Denmark and other countries of Europe who trade with Britain. The export and domestic trade of Canada is considered."

The University of Manitoba seems to be doing the most of any of the academic institutions in Canada from whom replies were received in respect to marketing education. Below is quoted quite fully an outline of the work done there:

"A. Teaching work done by myself in Marketing (Degree Students):
1. Agricultural Commerce.
2. Marketing of Farm Products.
3. Co-operation.
(The last two courses are given to the graduating class for a full year. Two lectures and one seminar a week. Besides this they get statistics and other courses in Economics.)

"B. Extension—Country lectures on demand.

"C. Research—The Department has one major research problem under way all the time.

"D. Bulletins and Special Articles.

"E. The writer is a Director of the Co-operative Marketing Board of Manitoba.

"F. Improvements—Appropriations for Economic Department are at present inadequate. Then we have too heavy a teaching program and no money for research."

At the University of Alberta, besides the regular lecture work, special short courses and special lectures over the radio are given.

At Macdonald College lecture work, extension work and the gathering of up-to-date statistical information in regard to prices are included in their work in Marketing Education.

The work of Government officials has to do mainly with the compilation of statistical information and reports and also the charge of inspection and grading of products. In some Provinces they also encourage farmers to form their own co-operative associations and pools. One or two quotations ought to suffice to demonstrate the nature of their work. Thus a member of the Markets Intelligence Service says:

"The work in marketing education with which I am concerned has to do with livestock market reports, analysis of the livestock situation, and the direction of the radio markets service."

The Chief of the Seed Branch at Ottawa says regarding his work:

"The general policy of the Seed Branch includes the establishing of grades and standards for certain farm products and the encouraging of better methods of marketing in this connection. Assistance is given in organizing seed centres, obtaining up-to-date machinery and equipment, and in marketing the products. A markets division publishes bi-monthly market reports and advises farmers and their organizations by correspondence."

A member of the Horticultural Service in Quebec has this to say:

"All the organization work concerning co-operation belongs to our Department, forming a special service whose head or chief has followed, over in Europe, special courses on Political Economics and who has travelled and visited nearly every country in the world, with a view to gathering information on the success of the co-operative work done in the different countries. This head officer is assisted by a committee composed of the heads of the different branches of the Department of Agriculture, of Professors at Agricultural Colleges, of 'Agronomes' and of representatives of co-operatives."

The marketing educational work of the co-operatives seems to be largely dependent upon printed pamphlets, circulars, field men, and the holding of meetings at rural centres. However, some of these organizations have distinctive methods of their own.

A Western correspondent tells of the work of a Board of Trustees for the disposal of the surplus of wheat-pool monies:

"This Board financed a trip of a number of co-operative leaders to the American Institute of Co-operation at Chicago last summer. They are purchasing complete records of all the sessions of the Institute and placing them in the libraries of the agricultural schools, at the University (of Alberta) and in certain city libraries also. They are also laying plans for a co-operative conference to be held in Alberta next summer."

A representative of the Manitoba Wheat Pool writes thus:

"I would say that we have here an Educational and Publicity Department The idea behind it is not to teach co-operative marketing but rather to encourage the acquisition of knowledge in the principles of the movement. It is responsible for the publication of the 'Scoop-Shovel'. The Department has a library of some two thousand volumes. These include practically all those dealing with the subject of co-operation, others on sociology, political economy, history and travel. The cost of the Department is maintained by the deduction of one-twentieth of a cent per bushel on all grains handled by the Manitoba Pool, and the authority is given through resolution passed at the Annual Meeting each year by the shareholders."

The work of the Manitoba Co-operative Marketing Board is classified under the following headings:

"1. Miscellaneous meetings at country points.
2. Short Courses of two or three days' duration.
3. Publicity through the columns of the press and periodical talks over the radio."

"How in your opinion might this work be improved?"

The improvements recorded most frequently were those of research, education, accurate statistical information and experimental work.

5. *"What is your personal opinion with regard to marketing education in your Province and in Canada?"*

In this connection two of our correspondents write:

"We are satisfied that marketing education is being well looked after at this University (Manitoba)".

Another offers the opinion:

"I feel that more attention and more effort could be given to provide educational matter in respect to marketing in this Province."

Another correspondent writes:

"I think that on the whole marketing is receiving as much attention as it deserves. There is a tendency to overrate its importance, even though its importance is great."

Another interested in marketing education in Canada, states:

"There is very strong need for marketing education throughout Canada, in order that when organizations are in search of men for executive positions where the requirement is that there should be an economic success from the position rather than a position involving research and investigation, then such men will be more generally available than at present."

Another expresses himself thus:

"It is exceedingly unfortunate that our Canadian farmers have been trained by agricultural colleges and experimental stations largely in the matter of production without due attention being given to the standardization and marketing of the products of their labour."

Another couches his ideas in the following words:

"Marketing has not received proper attention from the Department of Agriculture. This applies to both the Dominion and Provincial Governments. Too much

emphasis is placed on production and not enough on marketing. There should be more research work carried out. A Dominion Markets Division is needed. This division should work in close association with the Provinces in establishing better markets and popularizing Canadian products abroad."

A very practical suggestion is forthcoming from a member of the Markets Intelligence Service:

"In Canada there is a tendency to belittle the value of the radio as a medium through which the farmer may know his market but I would like to say that our experience here, and we have had considerable during the last half decade, is that if we do not take the opportunity offering today to put across a service in this regard, we shall in a short time regret our importunity. In the United States the Government has a regular radio markets service and has a chain of stations issuing each day a very excellent farm service. It is my opinion that the Federal Government should have in its Department of Agriculture a radio service which would organize a service throughout the country and provide to the various stations information and speakers so as to give the producer service of a high quality at all times."

During the course of the answers to this question some warnings were apparent from men who are well placed to criticize. Thus:

"It is before all a matter of public education. We must first create a public spirit favorable to the co-operative marketing. Up to now, we have striven too much to educate the producers' mentality and not enough that of the seller and of the consumer. One cannot, however, succeed without the help of the other two. Any agricultural work done in view to facilitate the sale of products, must extend altogether to the three classes of individuals interested: producers, sellers and consumers. Otherwise there will always be something lacking to the success of our work."

Another holds that:

"Throughout Canada at the present farmers are apt to have very exaggerated notions of what markets and marketing can do for them and they are too content to excuse themselves from any shortcomings in production which, in many cases, are the first steps to successful marketing."

Another believes that:

"The tendency at present seems to be to pay more attention to the organization of pools and whether contracts are necessary or not necessary, while neglecting very largely the Principles of Economics and the Principles of Marketing along the lines which, however reluctant we may be to admit the fact, a great deal of spade work remains still to be done."

Thus according to these three criticisms we must be careful that we educate the public and sellers as well as the producers; we must take care that we do not give false impressions of what scientific marketing can do; and before we proceed very far, we must make certain that the fundamental ground work of Economic Principles is there that we may not build up castles on disappearing sands.

An agricultural graduate writes:

"Really the average agricultural student or graduate is so poorly trained in marketing matters that in a way we have almost ceased to look to that source of supply for men to fill vacancies in the kind of Departmental work in which we are engaged. Men of good business education with a working knowledge of agriculture, who have had several years training in the actual work in hand are proving to be better qualified to fill the senior vacancies."

6. *"Any other comments?"*

Only two men have anything to say here that has not been repeated elsewhere. The substance of one correspondent's contribution regarding the above question is set forth thus: that many trained men are needed by the various co-operative organizations in Canada today and that the future will only bring with it an intensification of that demand. Thus he would wish

to see the Universities take hold of the field quite seriously in order that those men, now lacking, may be available in the future.

One prominent man has two objections to state. First that there is no association for Economists in Canada (he belongs to two such societies in the United States) and he says: "I would be greatly interested in a real attempt to organize an economic group in the C.S.T.A." His second objection is that although "many departments have not an economist in any Branch, yet the production men do not hesitate to enter and speak as prophets in the marketing (and the Farm Management) field."

Editor's Note:—The Committee on Marketing Education for 1928-29, appointed at the recent annual convention of the C.S.T.A., is composed as follows:—Dean F. M. Clement, University of British Columbia, chairman. Dr. D. A. McGibbon, University of Alberta. Prof. A. M. Shaw, University of Saskatchewan. Prof. H. C. Grant, Manitoba Agricultural College. Mr. W. H. J. Tisdale, Canadian Co-operative Wool Growers Ltd., Toronto. Mr. J. Coke, Ontario Agricultural College. Mr. P. A. Fisher, Burlington, Ont. Mr. H. S. Arkell, Dominion Live Stock Commissioner, Ottawa. Dr. J. E. Lattimer, Macdonald College. Mr. J. B. Cloutier, Dept. of Agriculture, Quebec. Mr. W. V. Longley, Nova Scotia Agricultural College. Mr. J. A. Clark, Dominion Experimental Station, Charlottetown. Prof. H. C. Bois, Oka Agricultural Institute.

BY-LAWS OF THE CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS (Incorporated)*

Arcticle 1. The Head Office of the Society shall be at the City of Ottawa, in the Province of Ontario, or at such other place as the Board of Directors may from time to time determine.

Seal

Arcticle 2. The seal, the impression of which is stamped upon the margin hereof, shall be the common seal of the Society by which all bonds, debentures, contracts and sealed instruments of the Society shall be attested under the hands of the President or a Vice-President and General Secretary of the Society, or in the absence of either or all of them, by such officer or director as may be appointed for that purpose by resolution of the Board of Directors of the Society.

Membership

Article 3. There shall be four classes of members—Regular, Life, Student and Honorary.

A. A regular member must be:

(1) A graduate in agriculture from a university or college of recognized standing, or

(2) A graduate of a university or college who is engaged primarily in agricultural research, administration, education, extension work, publicity, experimental problems or other forms of allied work of a scientific or managerial nature, or

(3) A non-graduate who is engaged primarily in agricultural research, administration, education, extension work, publicity or experimental problems and be accepted as provided for in the by-laws.

B. A Life member shall be a regular member who subscribes a Life Membership fee as provided for in the by-laws.

C. Student members shall be those who are senior students pursuing a degree course at an agricultural college of recognized standing.

D. The Honorary members' class shall be composed of persons not eligible for regular membership, who have rendered the profession valuable or special service. They shall be elected as provided for in the by-laws.

E. From the Regular members there shall be chosen a body of "Fellows" not exceeding thirty in number. The title "Fellow" shall be granted for professional distinction only, and be bestowed as provided for in the by-laws.

F. Applications for membership must be made in writing to the Secretary of the Local Branch, or the General Secretary, for recommendation to the Membership Committee of the Board of Directors.

G. "Fellowships" are granted upon recommendation made by the Board of Directors, or a sub-committee of that body, after such recommendations have been passed upon and confirmed by a two-thirds vote of the delegates at

*Adopted at the Eighth Annual Convention of the Society, Quebec, P.Q., June 13, 1928.

any annual convention. Any Regular member may make recommendation for a fellowship through the prescribed channels.

H. It shall be provided, however, that until all the vacant "Fellowships" are filled, not more than five may be appointed at any one annual meeting.

I. Honorary members may be elected upon nomination by the Board of Directors at any annual meeting after acceptance by a two-thirds vote of the delegates.

J. Members who in the opinion of the Board of Directors have failed to maintain the dignity of the profession may be recommended for suspension by that body, but such recommendation, before being put into effect, will require to be substantiated by a two-thirds vote of the delegates present at the next annual meeting.

K. Members who send their resignation to any local secretary or to the General Secretary, or who fail to pay their annual dues within twelve months from their due date, shall automatically cease to be members of the Society.

Officers

Article 4. A. The officers of the Society shall be a President, two Vice-Presidents and an Honorary Secretary-Treasurer.

B. The Directors of the Society shall consist of the four officers named above together with one member from each local executive.

C. The President and other officers shall perform the usual duties of their respective offices.

Organization

Article 5. A. The organization of the Society shall be:

(1) The Board of Directors, consisting of the officers and members provided for in Article 4.

(2) The local branch executives.

B. No one shall be eligible for the Board of Directors who has not been a member of the Society for one year.

C. The Board of Directors shall be the business body of the Society and as such shall transact all general business of the organization. It shall appoint the General Secretary-Treasurer, and determine his salary. It shall be responsible for all standing committees functioning in a manner satisfactory to the best interests of the Society.

D. Upon the application of twenty members, or, under special circumstances, a smaller number, the Board of Directors may permit the formation of a local branch, providing, however, that there shall be at least one local branch in each Province, irrespective of the number of members in that Province. Each local branch shall be governed by its own constitution and by-laws drawn up in general along similar lines to the by-laws of the Society. A copy of each local branch constitution and by-laws shall be sent to the Board of Directors which must approve them before they are valid.

Management

Article 6. The affairs and business of the Society shall be managed by such officers and committees and under such restrictions relating to the duties and powers of such officers and committees as may be provided for in the

by-laws, such by-laws to make provision for the employment of a paid General Secretary-Treasurer.

MEETINGS

Article 7. A. There shall be an annual meeting of the Society and, except under special circumstances, this shall be held alternately in Eastern and Western Canada.

B. Meetings of the Board of Directors or meetings called by it shall be arranged as may be necessary to carry out the objects of the Society, where not specified in the bylaws.

C. QUORUMS: One third of the members of the Board of Directors shall constitute a quorum for the transaction of business, and two-fifths of the elected delegates shall constitute a quorum for any special general, or annual meeting.

D. PLACE OF MEETING: Each annual meeting shall fix the place of the next annual meeting, or shall delegate this duty to the Board of Directors.

E. The fiscal year of the Society shall commence on June first of each year, and the annual meeting shall be held as soon thereafter as is deemed advisable by the Board of Directors.

F. Each local branch shall be entitled to send to the annual meeting one delegate for every twenty members and any majority fraction of twenty members.

G. Except where it may otherwise be specified in the by-laws, all voting at annual meetings is reserved for official delegates.

H. Notification of the place and date of the annual meeting shall be sent by mail to each local executive at least two months before it is to be held.

I. The Board of Directors may call such other special meetings of the Society as may be necessary to carry on efficient work.

J. The members of the Board of Directors shall meet when and where they may decide.

K. Notification of the place and date of a Directors' meeting shall be sent by mail to each Director at least one (1) month before it is to be held, together with agenda of business to be considered, apart from that of a routine nature.

L. Local branches shall hold meetings as arranged by their Executives.

M. Notification of the place and date of local executive meetings shall be according to their own by-laws.

N. All questions arising at any meeting of the Society shall be decided by a vote of the delegates present as set out in these by-laws. The presiding officer of the meeting, may, in his discretion, call for a show of hands or a ballot.

O. Delegates to any meeting of the Society or Directors may vote by proxy, provided that such proxy is registered with the General Secretary previous to any meeting at which it is intended to be used and that the appointee mentioned in the said proxy is present in person and himself entitled to vote.

Fees

Article 8. A. All regular members, with the exception of those who make application for membership within one year after graduation, and members of affiliated societies as provided for in by-law 12, shall pay an initiation fee of five dollars.

B. Regular members shall pay an annual fee of five dollars.

C. Life members shall subscribe a fee of one hundred dollars.

D. Student members shall pay an annual fee of three dollars.

E. One dollar of each fee shall go to the local branch.

F. All fees shall be payable either to the local secretary or to the General Secretary.

Elections

Article 9. A. Nominations for President, two Vice-Presidents and Honorary Secretary-Treasurer shall be valid if received by the General Secretary on or before March 15th, provided they are signed by ten regular members in good standing. All valid nominations shall be placed before the Ballot Committee, which shall prepare from them such a ballot as may best enable the members to give a clear expression of their wishes when voting. This ballot must be submitted to each local branch ten days before being distributed.

B. The election of these officers shall be conducted on the proportional representation system, and shall be by mail ballot; every regular member in good standing shall be entitled to cast one ballot which shall be sent out by the General Secretary not later than April 10th, and these shall be counted by a Committee consisting of the General Secretary, one member of the Board of Directors and a third party not a member of the Society, who shall be selected by the Board of Directors.

C. When the ballots for the annual election of officers are being counted, if the first Vice-President elected be English-speaking, only the French-speaking candidates shall be considered for the position of second Vice-President or vice versa.

D. All ballots shall be the regular form of ballot used by the Proportional Representation Society of Canada. These shall be supplied together with one "Voting Envelope" and one "Identification Envelope." On the face of the "Voting Envelope" the following shall be printed:—

(1) "Do not write anything on this envelope."

(2) "After marking your ballot enclose it in this envelope and seal."

(3) "Put this envelope (your ballot envelope) into the identification envelope."

(4) "Write your name and address plainly on the upper left hand corner of the identification envelope."

(5) "Return your ballot enclosed in the two envelopes to the General Secretary."

E. All officers shall be eligible for re-election. Vacancies shall be filled by appointments by the Board of Directors or by nomination and election at any regular or special meeting.

Order of Business

Article 10. The order of business at all meetings of the Society or meetings of the Board of Directors shall be as follows:—

(1) Minutes.
(2) Business arising from minutes.
(3) Correspondence.
(4) Reports of Committees.
(5) Unfinished business.
(6) Election of Officers and Committees.
(7) New business.
(8) Resolutions.

This order may be varied at any meeting by a two-thirds vote of the delegates present.

Standing Committees

Arcticle 11. Within one month from the date of the annual meeting the Board of Directors shall appoint any Special or Standing Committees of the Society as required by by-laws. Nominations for such Committees may be made by any member or by the Nomination Committee at the date of the annual meeting.

A. The Committees of the Society shall be:—

(1) On Membership.
(2) On Finance.
(3) On Progress.
Which shall be sub-committees of the Board of Directors.
(4) On Research.
Which shall be a standing committee, together with such others as may be deemed necessary.
(5) On the Ballot.
Which shall be appointed by the Board of Directors.
(6) On Resolutions.
(7) On Nominations.
(8) On By-laws.
Which shall be nominated and elected by and for each annual meeting, together with such other temporary committees as may be necessary for the efficient working of the annual meeting.
(9) Such permanent Committees as may be appointed by each annual meeting to act upon its decisions.

B. The personnel of the Standing Committees shall be reviewed by the Committee on Nominations at each annual meeting, which committee shall make recommendations for re-appointments and re-organization of all Standing Committees. Other Committees shall be elected at each annual meeting or shall be appointed by the Board of Directors.

C. It shall be customary, but not obligatory, that the Chairman of each Standing Committee shall be a member of the Board of Directors. Each Committee shall consist of at least three members with power to add to their number.

D. The duties of the Committees shall be as follows:—

(1) The Membership Committee shall receive, consider and pass upon all applications for membership and resignations of membership. It shall have power on behalf of the Society to deal finally with same. At its discretion it may delegate that power to the Board of Directors.

(2) The Progress Committee shall devise means for stimulating the interest of the members in the work of the Society and shall actively interest itself in securing new members and new locals. It shall consider new plans and policies for the Society.

(3) The Research Committee shall investigate the possibilities for research work by the members of the Society.

Affiliations

Article 12. Any Society having as one of its objects the advancement of any branch of agricultural science may be admitted as an affiliated society.

A. Any Society conforming to the requirements of this by-law as to eligibility, may become affiliated with the Canadian Society of Technical Agriculturists, if and when at least seventy-five per cent of its eligible members have been duly admitted to membership in the Canadian Society of Technical Agriculturists, such members of affiliated Societies not being required to pay the initiation fee if their application is received within twelve months after they become members of such affiliated societies.

B. Application for affiliation must be made in writing to the Board of Directors and be submitted for approval at the annual meeting.

C. Affiliated Societies may hold meetings during the annual meeting and programmes of such meetings will be included in the convention programme. Affiliated societies may also have the privilege, at the discretion of the Editorial Board, of using the official organ for the publication of papers, addresses, etc.

Funds

Article 13. Funds for the purpose of the Society may be raised by assessment upon each regular member by the Finance Committee, provided that a four-fifths affirmative vote of the registered delegates at any annual meeting be obtained.

Changes of By-laws

Article 14. A. The by-laws of the Society may be amended or added to by a majority vote of the delegates present at the annual meeting.

B. Any amendment, deletion or addition to the by-laws must be submitted to, and secure the approval of, the Secretary of State of Canada, from which date it shall become effective.

C. Notification of any proposed amendment must be sent to the General Secretary before April 1st.

D. The General Secretary shall forward copies of all proposed amendments to the Secretary-Treasurer of each local executive before May 1st.

Editorial Board

Article 15. A. An Editorial Board shall be appointed by the Board of Directors which shall consist of two members from each division of agriculutre, one member to retire each year from each division, the retiring member to be eligible for re-appointment.

B. The duties of the Editorial Board shall be to assist the Editor of the official organ of the Society in reviewing articles submitted for publication and in passing upon the merits of same, and also to assist in collecting articles suitable for publication.

Auditors

Article 16. Auditors shall be appointed each year by the Board of Directors ,whose duty it shall be to audit the books of the Society, to certify to the correctness of same, and to undertake any further work attached to the work of auditing the accounts of the Society.

Borrowing By-law

Article 17. The Directors may from time to time borrow money from any Chartered Bank upon the credit of the Society, limit or increase the amount to be borrowed, hypothecate, mortgage or pledge the real or personal property of the Society or both, and give promises and agreements to give security to secure any money borrowed for the purposes of the Society; also, may give additional security at any time for any money borrowed or

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Editor's Note:—The Canadian Society of Technical Agriculturists became incorporated under Dominion Charter on June 9th, 1928. The foregoing by-laws, adopted at the Eighth Annual Convention of the Society have been submitted to the Secretary of State for Canada for approval and cannot be amended in future without the approval of his office. The total membership of the Society at the time of incorporation was 1,023.

SYNOPSIS DE NOS DONNEES ACTUELLES SUR LA DIARRHEE BLANCHE BACILLAIRE DES VOLAILLES.*

R. Frere Gabriel.
Institut agricole d'Oka, La Trappe, P.Q.

Cette maladie est certainement le pire fléau que l'aviculteur puisse rencontrer. Elle semble commune en Canada. Durant la saison d'éclosion, elle se manifeste dans toute son ampleur et constitue la maladie la plus importante de toute la pathologie aviaire, surtout dans les troupeaux où une race a atteint un haut degré de perfectionnement.

John Mohler, le chef du Bureau de l'Industrie animale des Etats-Unis, disait: "Il n'y a aucune maladie dont l'étude soit plus d'actualité que la diarrhée blanche des volailles, car elle donne un coup mortel à la source même de l'industrie avicole qui est la production des jeunes."

C'est une maladie contagieuse qui survient chez les poussins quelques jours après l'éclosion et qui entraîne une grande mortalité. Chez les adultes, elle est généralement chronique et se localise de préférence, chez la poule, dans l'ovaire. Chez les poussins, elle se traduit à l'extérieur par un ensemble de symptômes dont le principal est la diarrhée, d'où le nom donné à cette maladie. La cause de l'affection, c'est le Salmonella Pullorum qui est un court bacille, immobile, Gram négatif, ne formant pas de spore et appartenant au groupe des paratyphiques. Le microorganisme est facilement détruit par les antiseptiques, ainsi le sublimé corrosif au millième le tue en 30 secondes; l'acide phénique à 1% le tue en 5 minutes, à 5% en 30 secondes; enfin la créoline à 1% le tue en 5 minutes. Cette connaissance est très importante pour la désinfection.

Extension de la Maladie.

Il est impossible de préciser d'une manière exacte son extension. Jusqu'ici il y a eu très peu d'études épidémiologiques faites à ce sujet. Les travaux sur cette maladie, commencés par Rettger en 1900, se sont surtout faits aux Etats-Unis. Le Collège vétérinaire de Guelph fait, depuis plusieurs années, un excellent travail sur la diarrhée blanche. Dans Québec, le Collège Macdonald et l'Institut agricole d'Oka s'occupent activement de cette question. Partout où l'on s'en occupe, on ne tarde pas à constater sa présence. Il n'y a pas de doute qu'elle existe dans toutes les localités où l'on fait de l'aviculture.

Symptomes et Lesions.

Chez les poussins.—Les poussins ont un air hébété, se tiennent sous l'éleveuse ou sous la poule. Ils se tiennent isolés, pépient constamment et laissent échapper une plainte au moment de la défécation. Les plumes deviennent rugueuses et les ailes sont tombantes. Ils mangent peu et semblent incapables de saisir leur nourriture.

L'évacuation de matière blanchâtre, caractéristique de la maladie, apparaît bientôt; toutefois, dans les cas aigus, l'oiseau meurt avant d'avoir donné des signes de diarrhée. L'excrément est blanc-crème, et, quelquefois, mêlé de brun. Il est plutôt blanc chez les jeunes poussins. Dans beaucoup

*Conférence fait devant l'Association avicole de Montréal, le 29 juin, 1928.

de cas, cette matière adhère aux plumes qui entourent l'anus en assez grande quantité pour obstruer complètement le cloaque.

Souvent le sujet a le dos rond et un gros ventre. L'abdomen est parfois proéminent en arrière.

L'examen post-mortem démontre que le foie est de couleur jaune ocre, et le jaune de l'œuf n'est pas absorbé dans la majorité des cas; le jabot est généralement vide; les intestins sont pâles, le coecum est rempli de matière grisâtre, molle.

La grosseur du jaune inabsorbé est variable. Parfois il est à sa grosseur primitive. Sa couleur varie de jaunâtre à verdâtre. Le contenu est de consistense variable, fluide ou pâteuse et sans odeur.

Le sujet a une apparence émaciée et les muscles sont ictériques.

Chez la poule.—Chez la poule adulte l'infection est généralement localisée dans les ovaires, mais elle peut être constatée aussi sur d'autres parties du corps.

Dans l'ovaire de la poule l'infection est caractérisée par la présence d'ovules angulaires, solides, décolorés, dont la grosseur est très variable. Le nombre d'ovules infectés varie aussi selon les individus. Ces ovules peuvent se rompre et amener une péritonite, ou une obstruction de l'oviducte et la formation de kystes. Dans certains cas, les intestins adhèrent tellement au péritoine qu'il est presque impossible d'en faire la dissection. Dans d'autres cas, on découvre des abcès sur le corps ou dans les parenchyme des viscères.

Source et Modes d'Infection.

Le contrôle de cette maladie infectieuse, dépend beaucoup de la connaissance que l'on a de la source de l'infection et du mode de transmission.

Dans la diarrhée blanche, la maladie suit un cycle bien défini. Tous les sujets infectés ne meurent pas, beaucoup deviennent adultes et hébergent les bacilles dans leurs ovaires. Les œufs que pondent les poules infectées, peuvent également l'être, et infecter l'embryon et le poussin dans la coquille. Plusieurs poussins meurent dans la coquille, parce qu'ils sont incapables d'en sortir; d'autres meurent peu de temps après l'éclosion; enfin d'autres survivent et deviennent adultes et sont les agents de l'infection.

Lorsque des poussins infectés viennent en contact avec des poussins en santé, ils peuvent leur transmettre l'infection surtout par leurs matières fécales.

Avec ces données, on peut contrôler la maladie. La méthode de contrôle consiste dans trois opérations.

1.—Tous les sujets du troupeau doivent être soumis à l'épreuve de l'agglutination afin de déterminer quels sont les oiseaux hébergeant le bacille.

2.—Tous les sujets qui donnent une réaction positive doivent être immédiatement éliminés.

3.—On doit prendre toutes les mesures sanitaires possibles.

Elimination des Reacteurs.

L'élimination des réacteurs semble être la pierre d'achoppement du succès dans la pratique de cette méthode.

Lorsqu'il découvre des réacteurs parmi ses sujets de valeur, le propriétaire s'objecte à l'élimination de ces sujets. Sans doute, la perte de tels sujets est regrettable, mais elle est nécessaire pour extirper la maladie. Un sujet qui vaut $25.00 est une menace aussi considérable à la santé du troupeau qu'un sujet de moindre valeur, qui ne vaut qu'une piastre. Dans les fermes ordinaires, les volailles ont à peu près la même valeur pour le marché que pour l'élevage.

Il est à peu près établi que les réacteurs sont de pauvres producteurs. Leurs œufs sont stériles, ou bien l'embryon infecté meurt avant d'éclore ou peu après l'éclosion, selon le degré d'infection. Tout bien considéré, il est préférable de se débarrasser rigoureusement de tout réacteur. Un seul sujet infecté, laissé dans un troupeau sain, suffit pour constituer un foyer d'infection qui sera de nouveau le point de départ de la maladie.

L'Incubateur Source d'Infection.

Il est établi que le bacille de la diarrhée blanche peut être transmis aux poussins normaux par un incubateur qui a été infecté par des œufs contaminés. Ceux qui font de l'incubation doivent être attentifs à prévenir toute possibilité d'infection, en ne mettant en incubation que des œufs provenant de poules qui n'ont pas la diarrhée blanche ou qui ont été éprouvées.

Influence de la Maladie sur la Fecondite et l'Eclosion.

L'influence de la maladie sur la fécondité et l'éclosion est d'une importance capitale pour ceux qui font de l'incubation au point de vue commercial. Dans beaucoup de cas, il y a une différence marquée au point de vue de la fécondité des œufs et de l'éclosion des poussins, entre les œufs provenant de sujets réacteurs et non-réacteurs. On peut facilement établir cette différence en observant les résultats, qui sont fortement en faveur des sujets non-réacteurs.

Pertes qu'Occasionne la Maladie.

Des pertes considérables sont occasionnées par la maladie. Certaines peuvent être établies directement, par exemple: la mortalité des poussins. D'autres sont plus difficilement appréciables. On sait que l'infection de l'ovaire de la poule pondeuse diminue chez elle la production, la fécondité et l'éclosion des œufs. L'évaluation exacte des pertes causées par la diarrhée blanche est très difficile, car il y a d'autres maladies produisant des symptômes cliniques identiques à ceux donnés par une infection par le Salmonnella Pullorum C'est ici qu'intervient le laboratoire pour faire le diagnostic différentiel des affections à aspect similaire.

Il y a beaucoup de discussion en ce qui regarde la productivité des réacteurs. De nombreuses expériences ont démontré que le pourcentage de fécondité est plus élevé chez les non-réacteurs. La maladie cause des pertes appréciables à celui qui fait de l'incubation en diminuant le nombre d'éclosions. Ces pertes sont aussi grandes pour l'acheteur de poussins d'un jour. C'est surtout lui qui comprend l'avantage d'avoir des poussins non infectés. Très souvent la perte d'un seul poussin serait suffisante pour payer les frais de laboratoire pour faire l'épreuve d'un sujet adulte.

Diagnostic.

Nous avons vu dans le mode de transmission que l'organisme microbien est transmis de génération en génération dans le corps des oiseaux atteints

durant le jeune âge, mais qui se sont apparemment guéris tout en continuant à être des porteurs de germes durant la période de production et ayant la malheureuse faculté de donner des œufs infectés qui répandront l'infection. Alors, comment reconnaître les porteurs de germes, qui souvent présentent l'apparence d'une bonne santé.

Il existe deux moyens de faire le diagnostic de la maladie:

1.—L'épreuve intradermique,

2.—L'épreuve de l'agglutination.

L'Epreuve Intradermique.

On a tenté de faire avec le Salmonella Pullorum, un produit identique à la tuberculine ou à la malléine, et on lui a donné le nom de Pullorine. On fait l'injection du produit dans la peau d'un barbillon. La lecture se fait au bout de 24 heures Une réaction positive est indiqué par un engorgement oédémateux du barbillon injecté.

Les résultats sont cependant si inconstants qu'on a rarement recours à ce procédé de diagnostic.

Comparaison entre l'Epreuve d'Agglutination et de Pullorine pour la Determination des Porteurs de Germes.

Voici la conclusion d'une expérience faite avec 57 poules à la Station expérimentale du Wisconsin:

"Il est évident que l'épreuve à la Pullorine telle qu'elle est présentement, n'est pas aussi juste que l'épreuve de l'agglutination."

Et celle du Collège vétérinaire de Guelph: "l'épreuve de l'agglutination a été plus satisfaisante que l'épreuve à la Pullorine dans les troupeaux où la comparaison a été faite."

Enfin celle de Edwards et Hull: "D'après nos statistiques il est évident que l'épreuve d'agglutination est plus fiable que l'épreuve intradermique."

L'Epreuve de l'Agglutination.

Pour faire l'épreuve de l'agglutination d'un troupeau, pour déterminer quels sont les oiseaux porteurs de germes, il faut faire les opérations suivantes:

1.—Préparation du troupeau.
2.—Collection du sang.
3.—Soins à donner au sang.
4.—Préparation de l'antigène.
5.—L'épreuve.
6.—L'interprétation des résultats
7.—Mesures consécutives à l'épreuve.

1.—*Préparation du troupeau.*—Chez les oiseaux qui produisent beaucoup ou qui sont bien nourris, le sang contient des matières grasses qui nuisent à la lecture des épreuves. Dans le but d'avoir un sérum clair, on a conseillé le jeûne des volailles destinées à fournir les échantillons de sang. Mais ce jeûne entraîne une diminution d'œufs assez considérable pour faire hésiter l'aviculteur dans l'emploi de ce procédé.

Un moyen pratique serait de substituer au jeûne absolu un jeûne relatif. La veille de la prise de l'échantillon, on enlève la pâtée le midi, et le grain le soir. On prend l'échantillon de bonne heure le matin, et l'on donne immé-

diatement après et la pâtée et le grain. Cette méthode a l'avantage d'amener une diminution moins considérable du nombre d'œufs.

Aujourd'hui, avec l'emploi de l'antigène alcalinisé, le jeûne n'est plus nécessaire.

Bien entendu, chaque oiseau aura une bande numérotée à la patte et le numéro de la bande doit correspondre au numéro de l'échantillon.

2.—*Collection du sang.*—La meilleure saison de l'année pour faire l'épreuve du sang n'a pas été déterminée d'une manière définitive; mais le moment qui paraît préférable c'est celui qui précède immédiatement la saison d'incubation, à temps toutefois pour ne pas mettre les sujets hors de production. Un autre moment avantageux est la semaine qui précède la mise en quartier d'hiver.

La longueur du temps entre l'extraction du sang et l'épreuve ne paraît pas devoir influencer le résultat de l'expérience, si le sérum est resté stérile et frais.

Pour faire la saignée, un aide tient l'oiseau et met en évidence la face interne de l'aile. Les plumes sont enlevées sur une petite étendue, près de l'articulation huméro-radiale, où passe une veine assez apparente.

On peut soutirer le sang soit à l'aide d'une aiguille hypodermique, soit à l'aide d'un bistouri. Lorsqu'on se sert de l'aiguille, on place un doigt sur la veine entre l'articulation et le cœur afin de la faire gonfler. On introduit ensuite l'aiguille, d'abord dans la peau, puis dans la veine.

Avec le bistouri ou le scalpel, on fait une incision longitudinale nette à la veine, et on laisse couler le sang dans un tube stérilisé. On prend généralement 2 cc. de sang. Chez les oiseaux qui saignent difficilement, on en prend un peu moins.

Dès que la prise d'échantillon est terminée, on bouche le tube et on l'incline aussitôt pour la coagulation du sang. Il faut bien veiller à ce que les tubes ne contiennent pas d'eau, car la présence de l'eau rendrait le sang impropre à l'usage en produisant l'hémolyse.

3.—*Soins à donner au sang.*—Le sang est déposé dans un endroit frais pour la nuit. Si le tube a été bien incliné pour la coagulation, on a, le lendemain, un sérum bien séparé du caillot. Dans le cas contraire, il faut briser le caillot à l'aide du fil de platine, et, soit faire la centrifugation du sang soit le laisser reposer une autre nuit. Mais si les tubes sont bien inclinés, il est rarement nécessaire d'avoir recours à cette opération.

Durant l'été, il faut tenir les échantillons dans un endroit frais. Durant l'hiver, il faut bien veiller à ce qu'ils ne gèlent pas, car il se produirait de l'hémolyse, le sérum serait rougeâtre, et la lecture serait difficile.

4.—*Préparation de l'antigène.*—L'antigène est une suspension de bacilles Salmonella Pullorum dans de l'eau physiologique, i. e. de l'eau salée à 0.85%.

On se sert généralement de plusieurs cultures d'origine différente. Les tubes sont ensemencés. Après une incubation de 24 à 48 heures, à 37.5° C, les cultures sont lavées avec de l'eau salée. Le liquide obtenu est filtré. L'antigène est ensuite dilué pour lui donner le degré d'opalescence désiré. On ajoute ensuite 0.3 pour cent de phénol, et on a un antigène pouvant se conserver plusieurs semaines, et même plusieurs mois, si on a la précaution de le tenir dans une glacière. Au moment de l'emploi, il est alcalinisé avec une solution à 2% de soude caustique.

Cette alcalinisation se fait à raison de 2 cc de la solution pour 100 cc d'antigène.

5.—*L'épreuve*.—Si nous mettons dans l'antigène (liquide opalescent contenant en suspension des Bacterium Pullorum), une certaine quantité de sérum d'un oiseau sain et qu'après l'avoir bien mélangé nous mettions les tubes à l'étuve pour la nuit, le liquide restera trouble, laiteux. Si nous mettons dans un autre tube de l'antigène et du sérum d'un oiseau infecté et que nous le laissions à l'étuve pour la nuit, le liquide, de trouble qu'il était, sera clair le lendemain matin et les germes qui étaient en suspension seront en amas dans le fond du tube. Ils sont agglutinés.

L'explication de cette agglutination repose sur le principe d'immunité que le sérum d'un oiseau infecté contient des agglutinines correspondantes.

Le point de l'épreuve le plus difficile à déterminer est celui de la dilution. Les bactériologistes ne sont pas d'accord sur ce point.

Dans certains laboratoires on n'emploie qu'un tube, i. e. une seule dilution; dans d'autres, deux dilutions, enfin un certain nombre trois, quatre et même cinq.

Au New York State Veterinary College, on emploie deux dilutions, une au quarantième et l'autre au soixantième.

A Guelph, on se sert d'un à cinq tubes, et, si on emploie un seul tube, on fait la dilution au cinquantième en mettant dans un tube 1 cc d'antigène et 0.02 de sérum.

A l'Institut agricole d'Oka, nous employons la méthode qui fut d'abord préconisée par Beaudette. Nous mettons 2 gouttes de sérum dans 4 cc d'antigène alcalinisé. Nous nous servons de rateliers ou tablettes en bois contenant 36 tubes. Une burette est utilisée pour mettre l'antigène dans les tubes. Quand le sérum et l'antigène sont bien mélangés les tubes sont mis à l'étuve pour 24 heures.

6.—*Interprétation des résultats*.—Tous les tubes positifs sont parfaitement clairs, et il y a un amas dans le fond. Les tubes négatifs sont restés opaques, il n'y a aucun changement dans l'apparence du liquide. Toute agglutination dans un tube ayant une dilution au cinquantième et plus est une réaction positive. Si on a eu recours au jeûne relatif suggéré plus haut, on a rarement de la difficulté en ce qui regarde la présence de matière grasse.

7.—*Mesures consécutives à l'épreuve*.—Après l'épreuve, tous les oiseaux réacteurs seront enlevés et les ustensiles (abreuvoirs, auges), ainsi que le poulailler, les incubateurs, etc., seront désinfectés à fond. Les sujets réacteurs seront envoyés au marché pour la consommation. Si l'aviculteur a des oiseaux de grande valeur et qu'il veuille en garder pour quelque temps, il doit les séparer du reste du troupeau. Ce système est dangereux, car il est toujours assez difficile d'empêcher tout contact avec les sujets malades.

Le système radical de l'abatage est le meilleur à conseiller à l'aviculteur qui veut se défaire de la maladie.

Valeur Pratique de l'Epreuve.

Weaver, à Ottawa, a cherché le taux de diminution des réacteurs à des épreuves consécutives. Il a trouvé une moyenne de 24% de réacteurs à la première épreuve. L'épreuve suivie de l'élimination des réacteurs fait diminuer considérablement le nombre de réacteurs, par conséquent, de porteurs

de germes, car à la deuxième épreuve il n'y avait que 5% de sujets réacteurs.

Traitement.

Disons tout de suite qu'il n'y a aucune méthode efficace de traitement.

Quand la maladie éclate parmi ses poussins, on comprend que le propriétaire cherche le plus possible à les sauver Cependant, il ne doit pas perdre de vue que les poussins qui ont eu la maladie restent porteurs de germes, et qu'il ne doit en aucun cas les employer pour la reproduction.

Depuis les découvertes de Metchnikoff au sujet des microbes produisant de l'acide lactique et son influence sur la flore intestinale en santé et en maladie, le problème a suscité beaucoup d'intérêt.

Du fait que la diarrhée blanche est une maladie intestinale et que la porte d'entrée de l'infection est le tube digestif, on a suggéré l'emploi des organismes produisant de l'acide lactique. On a conseillé l'emploi du lait sûr. Cependant, l'expérience a démontré que l'emploi du lait sûr est de peu de valeur pour contrôler la maladie, car elle affecte non seulement le tube intestinal, mais elle se répand dans toutes les parties du corps. Le lait sûr peut tout au plus servir comme antiseptique intestinal, mais ne saurait empêcher le cours de l'infection une fois introduite dans le corps.

L'emploi de solutions antiseptiques dans l'eau à boire, peut, dans certains cas, agir comme préventif, mais chez les poussins infectés, elle n'a pas une bien grande utilité.

Extirpation de la Maladie.

Quoiqu'on étudie cette maladie surtout parce qu'elle cause de grandes pertes chez les poussins, celles-ci sont probablement aussi très grandes chez les adultes.

Si les pertes sont si grandes et que l'on connaisse le mode d'infection qui se fait de génération en génération dans le corps des oiseaux atteints et de là dans l'œuf, et de l'œuf au poussin, on comprend qu'il devient facile de contrôler la maladie à condition d'être intransigeant en ce qui regarde l'emploi des moyens de contrôle.

Ces moyens ont déjà été donnés. Nous avons traité longuement de l'épreuve de l'agglutination et plus succinctement de l'élimination des réacteurs. Il reste à dire quelques mots du troisième facteur, qui est la désinfection.

La Desinfection.

Nous avons vu comment le poussin s'infecte et, après l'éclosion, comment il infecte son milieu ambiant. Il faudra donc désinfecter l'incubateur puis le poulailler et son contenu.

Desinfection de l'Incubateur.

Elle est d'une importance primordiale. Certaines machines peuvent être désinfectées avec des solutions antiseptiques, mais d'autres types se prêtent mal à ce mode de désinfection, par exemple ceux à courant d'air forcé. Dans ce cas, la méthode qui semble la plus pratique à l'heure actuelle est celle de l'emploi de l'aldéhyde formique et du permanganate de potasse.

Pour faire la désinfection, il faut:

1° Formol du commerce à 40%, qu'on étend de la même quantité d'eau.

2° Permanganate de potasse cristallisé.

3° Des vases de grandeur variable suivant le cubage à désinfecter, dans lesquels on verse la solution de formol sur le permanganate de potasse. On emploie 500 centimètres cubes de formaline dans 250 grammes de permanganate de potasse pour chaque 1000 pieds cubes à désinfecter.

Pour ce qui regarde le mode d'emploi, on verse, dans le récipient contenant le permanganate de potassium cristallisé, la quantité nécessaire de formaline diluée. Après 10 à 15 secondes, le gaz se dégage sous la forme d'un épais nuage qui se diffuse dans la pièce. Durant ces 10 secondes, on peut facilement fermer la porte. On laisse les vapeurs agir pendant six heures, temps amplement suffisant pour que la désinfection soit complète.

Il ne reste plus qu'à aérer ensuite jusqu'à disparition de l'odeur piquante du formol.

Il faut se servir d'un récipient suffisamment grand pour éviter le débordement de l'écume.

Ce mode de désinfection a les avantages suivants:

1° Suppression de tout appareil coûteux,
2° La fermeture hermétique n'est pas nécessaire,
3° Il est d'une grande simplicité,
4° Il ne présente aucun danger d'incendie,
5° Il est peu coûteux.

Desinfection du Poulailler.

Le temps nécessaire pour débarrasser un troupeau dépend d'un certain nombre de facteurs dont les deux principaux sont la régularité de l'épreuve et surtout la désinfection complète du poulailler.

Pour faire une désinfection complète, il faut d'abord faire l'évacuation complète du local, puis nettoyer, en enlevant le fumier, les aliments, les litières, les récipients, etc. Puis gratter les murs, les plafonds, les perchoirs, les auges, etc. Brûler tout le matériel à détruire et tremper les surfaces avec une solution antiseptique ou employer un pulvérisateur.

Il faut employer les désinfectants dans les proportions suivantes: Acide phénique à 5%. Il se prépare en mélangeant 7 onces d'acide pour chaque gallon d'eau.

Bichlorure de mercure, une once par 8 gallons d'eau.

Les antiseptiques à base de goudron (crésol) à raison de 7 onces par gallon d'eau.

Conclusion.

1° La diarrhée blanche est une maladie dont la cause est connue.

2° Le mode d'infection est connu.

3° Elle cause des pertes, non seulement par la mortalité des poussins, mais aussi par une diminution de fécondité et d'éclosion des œufs.

4° Ces pertes sont difficiles à évaluer, à cause de la confusion qui existe quant aux causes de la mortalité des poussins.

5° Le diagnostic de la maladie est facile à faire dans un laboratoire.

6° L'épreuve d'agglutination est le mode de diagnostic qui donne les meilleurs résultats.

7° Le mode de contrôle est clair.

8° Le contrôle est quasi impossible si l'éleveur refuse d'éliminer les réacteurs, s'il ne prend pas de précautions pour acheter des œufs provenant de poules non infectées, enfin s'il ne fait pas de désinfection.

CONCERNING THE C.S.T.A.

With this issue, *Scientific Agriculture* enters upon a new volume. Readers will notice that a decided improvement has been made in the quality of paper used in the journal, in order to provide better reproduction of illustrations. We believe that with this change the official organ of the Society compares favourably with similar publications anywhere in the world.

At the time of writing we are not certain that there will be sufficient funds available to permit any increase in the number of pages per issue. Such increase is needed because of the large number of manuscripts now being submitted for publication. We believe, however, that somewhere in Canada, within the limits which may reasonably be aproached for assistance of this kind, a satisfactory response will be given, and so we start the ninth volume of *Scientific Agriculture* with confidence that it will be completed satisfactorily without financial difficulties being faced.

The advertisement of the Tobacco By-products and Chemical Corporation, appearing in this issue, is an ideal announcement for a journal of this kind. We have always tried to convvince manufacturers that readers of *Scientific Agriculture* were interested particularly in new developments in agriculture and certainly the discovery that "Black Leaf 40" can be used successfully in the control of poultry lice, is worthy of special publicity of this kind.

A novel and efficient method for impressing upon farmers some publicity recently undertaken by the Dominion Live Stock Branch, has been reported by Mr. F. M. Nash, District Poultry Promotor for the Branch in Prince Edward Island. A short while ago the Poultry Division of the Live Stock Branch undertook a campaign of publicity to encourage farmers to produce and market clean eggs. In addition to articles in the Farm Press three Leaflets were issued which have received very wide distribution. Mr. Nash, in his culling work in P.E.I., tacks up in each poultry house a copy of one of these Leaflets and the fact that this is consistently brought to the attention of the producer is having very beneficial results. The Live Stock Branch will be pleased to send to any agricultural workers in Canada who would be interested in this matter a supply of the Leaflets referred to. They are available in both English and French.

The Civil Service Commission at Ottawa is advertising the following positions:—

Experimental Farm Assistant for Kentville, N.S. Initial salary $1,620 per annum, with increases of $60 per annum up to a maximum salary of $1,920. Applicants must have completed post graduate training in pomology. Applications close September 6.

Assistant to Dominion Animal Husbandman, Central Experimental Farm, Ottawa (Bilingual). Initial salary $1,620 with increases of $60 per annum up to a maximum of $1,920. Applications close September 13.

Applications for Membership

The following applications for regular membership have been received since June 1, 1928:—

E. C. Beck (Toronto, 1928, B.S.A.), Toronto, Ont.
Hector Beliveau (Laval, 1926, B.S.A.) Ste. Martine, P.Q.
H. L. Brouillard, (Laval, 1926, B.S.A.) Hebertville Station, P.Q.
W. R. Foster (Alberta, 1928, B.Sc.), Edmonton, Alta.
W. J. Harper (Alberta, 1928, B.S.A.) Claresholm, Alta.
S. O. Hillerud, (Alberta, 1920, B.S.A.) Claresholm, Alta.
W. G. Kirk (Saskatchewan, 1928, B.S.A.) Saskatoon, Sask.
Joseph Parenteau (Montreal, 1920, B.S.A.), Yamachiche, P.Q.
N. J. Thomas (Toronto, 1923, B.S.A.) Guelph, Ontario,
H. K. Walker, (Alberta, 1928, B.S.A.), Cayley, Alta.

Notes

J. C. Moynan (McGill '16) has received the appointment of Chief of Illustration Stations, Dominion Experimental Farms Branch. He has been Acting Chief since the death of John Fixter in August, 1927.

J. Norman Bird (Toronto '26) has changed his address to Macdonald College, P.Q.

W. R. Brown (Alberta '23) who has been Instructor in Science at the School of Agriculture, Vermilion, Alta., for the past three years, is taking post graduate work at the University of Minnesota. His address is 1404 Raymond Avenue, St. Paul, Minn.

A. P. MacVannel (Toronto '06) has been transferred as Agricultural Representative from Picton (Prince Edward Co.) Ont., to Milton (Hastings Co.), Ont.

W. A. De Long (Toronto '20) has received the degree of Ph.D. from the University of Minnesota and has been appointed Assistant Professor of Chemistry at Acadia University, Wolfville, N.S.

A. J. G. Maw (McGill '23) will be located at the Department of Genetics, University of Wisconsin, Madison, Wis., after September 1st. He has been taking special studies in Poultry Husbandry at Macdonald College, P. Q.

J. MacF. Bates (Toronto '22) who has been teaching science, agriculture and physical culture at Beamsville High School for the past five years has been appointed Principal of the High School at Burlington, Ont.

G. J. Spencer (Toronto '14) is returning to the Department of Zoology, University of British Columbia, Vancouver, B.C., after having spent some ten months in the Department of Biology at the University of Toronto.

E. K. Hampson (Toronto '15), Ontario representative of the N. V. Potash Export My., Montreal, P.Q., has opened an office at 17 Yates Building, Main St. East, Hamilton, Ont.

Miss Helen Milne (British Columbia '27), who has been Instructor in Poultry Husbandry at the Manitoba Agricultural College for the last year, has returned to British Columbia. Her address is 1285—11th Avenue West, Vancouver, B.C.

William Levine (McGill '26) has changed his address to 3768 City Hall Avenue, Montreal, P.Q.

W. F. Hanna (Alberta '22) has joined the staff of the Dominion Rust Research Laboratory at Winnipeg. He has been taking graduate work in Plant Pathology at the University of Minnesota.

A Savage (McGill '11) who has been at the Royal Veterinary College, Edinburg, Scotland, for the past year, has returned to the Manitoba Agricultural College, Winnipeg, Man. He was elected a Fellow of the Royal College of Veterinary Surgeons.

A. B. Jackson (Toronto '20) has changed his address to Bartonville, Ontario.

W. M. Chisholm (Toronto '16) has resigned from the James Fisher Advertising Agency to become associated with the Head Office of J. J. Gibbons Limited, 119 Wellington Street West, Toronto 2, Ont.

J. H. Bredin (Saskatchewan '22) is taking post graduate work at Columbia University, New York City, N.Y.

G. S. Matthews (McGill '24) is at the Dominion Entomological Laboratory, Chatham, Ont.

Rozemond Caron (Laval '25) is now with the Field Husbandry Branch, Department of Agriculture, Quebec, P.Q.

J. W. Howe (Alberta '25) has changed his address to Room 4, Federal Building, Mitchell, South Dakota, U.S.A.

W. G. Dunsmore (McGill '20) has joined the staff of the Dominion Live Stock Branch, 59 Victoria St., Toronto 2, Ont. He has been at the Central Experimental Farm, Ottawa, since 1921.

W. J. Tawse (Toronto '15) has changed his address to 750 Wilson Ave. N.D.G., Montreal, P.Q.

H. L. Bérard (Montreal '26), who is taking post graduate work at Cornell University, has changed his address to 210 College Avenue, Ithaca, N.Y.

J. H. Tessier (Montreal '25) is now at the Dairy School, St. Hyacinthe, P.Q.